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P. V. Cardon

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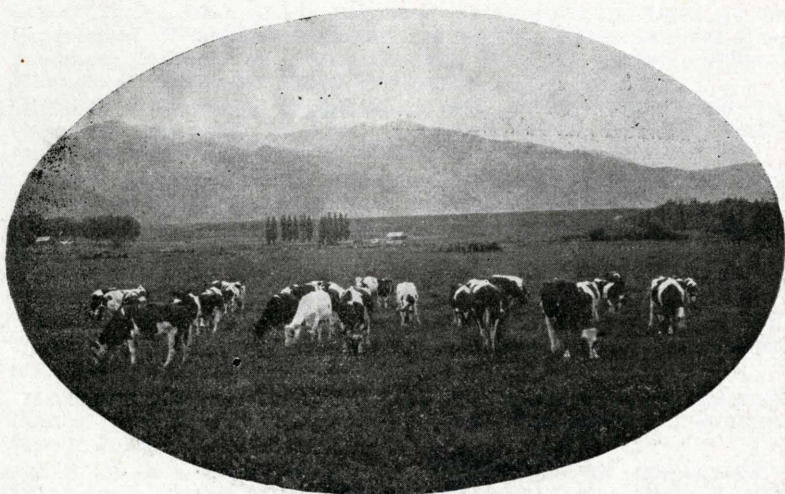
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Biennial Report, Utah Agricultural Experiment Station

JULY 1, 1930 TO JUNE 30, 1932

P. V. CARDON



Utah Agricultural Experiment Station

Utah State Agricultural College

LOGAN, UTAH

Biennial Report

Utah Agricultural Experiment Station

July 1, 1930 to June 30, 1932

President E. G. Peterson

Sir:

I have the honor to transmit the report of the Utah Agricultural Experiment Station for the biennium ending June 30, 1932. This report includes the reports of the various departments as well as other information pertaining to the work of the Experiment Station during this two-year period.

Respectfully submitted,
P. V. CARDON, Director.

STAFF CHANGES

Resignations

- Kenneth C. Ikeler, Dean of the School of Agriculture and Head of the Department of Animal Husbandry, as well as Station Animal Husbandman, resigned on September 30, 1930, to become General Manager of the Ogden Union Stockyards.
- George Stewart, Professor of Agronomy and Station Agronomist, resigned on September 30, 1930, to become Senior Ecologist, Intermountain Forest Experiment Station, U. S. Forest Service.
- H. C. Pulley, Assistant Station Bacteriologist, resigned on July 1, 1931 to continue his graduate study at an eastern university.
- Stella Sorenson Burnham, Stenographer in the Experiment Station, resigned on May 15, 1931.

Appointments

- R. J. Evans, Ph.D., former Director of Agricultural Extension in the Utah State Agricultural College, was appointed Station Agronomist, effective July 1, 1931.
- E. J. Maynard, formerly Associate Animal Husbandman at the Colorado Station, was appointed Station Animal Husbandman, effective March 1, 1931.
- Kenneth R. Stevens, Ph.D., graduate of Rutgers College, was appointed Assistant Station Bacteriologist to fill the vacancy caused by the resignation of H. C. Pulley.
- Vilate Jones, a graduate of the class of '31, Utah State Agricultural College, was appointed Stenographer in the Station Office, as of May 15, 1931.
- The following Graduate Research Assistants¹ were appointed in the fall of 1930: DeWitt Smith, George T. Blanch, and Floyd Clark.

General

A. L. Wilson who had been studying for his doctorate at Cornell Uni-

Acknowledgment: Acknowledgment is freely made for the work on this report by Blanche Condit Pittman, in charge of the Editorial and Publications Division. She is responsible for detailed compilation of pages 1-9 and 12-76 inclusive, as well as for summary of results from departmental reports and for the organization of the report as a whole.

¹Beginning July 1, 1931, graduate Research Assistantships were temporarily discontinued.

versity returned to the Station as Associate Horticulturist on April 1, 1931.

H. L. Blood, Ph.D. from Wisconsin University, returned to the Station as Associate Plant Pathologist, effective July 1, 1930; on July 1, 1931 he was raised in rank to Plant Pathologist. Dr. Blood also received appointment on July 1, 1931, as Agent with the Division of Horticultural Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture.

On August 1, 1931, Dr. F. B. Wann, Associate Station Plant Physiologist, also received part-time appointment with the Division of Horticultural Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture.

George Q. Bateman, in charge of the Dairy Experimental Farm, on January 1, 1931, received a part-time appointment as Agent with the Bureau of Dairy Industry, U. S. Department of Agriculture. Mr. Bateman will still retain his former relations with the Station.

Rollo W. Woodward, M.S. '30, Utah State Agricultural College, on July 1, 1930, was appointed Junior Agronomist, Office of Cereal Investigations, Bureau Plant Industry, to work in cooperation with the Station on wheat studies.

SALES

The sales for the biennium ending June 30, 1932, approximate but \$20,000, a decrease of nearly \$25,000 for the previous biennium. However, this decrease is easily accounted for by the present general economic and agricultural conditions.

OUTSTANDING EQUIPMENT PURCHASED

Outstanding equipment purchased on Station funds during the past two-year period includes the following:

Scientific and Technical

Minimum and chemical thermometers, combustion furnace, electric hotplates, hydrographs, moisture-inoculation chambers, torsion balance, Carver laboratory press, analytical balance, microscopes, pipetting machine, micro-manipulator, microtome, water still, haemocytometer, haemoglobinometer, snow tube, tubular spring balance, colorimeter, nephelometer, Tycos air thermographs (2), hygrothermographs (2), psychrometers (2), healthometer, micromanipulator, hot-water heater (and shed for housing), electric installation for hotbed equipment.

General Office

Desks(8), cameras, including Eastman View Camera², letter files, filing cases, chairs, photographic material, typewriters(8), Estate Heat-rola, oak tables, steel bookcases, typewriter desks, stenographic chairs, Monroe electric calculator, filing cabinet, section file.

Field

Traction alfalfa duster, drains on farm, 120-pound scale, No. 12 Kimball-Krough direct-flow turbine pump with 50 h. p. electric motor, 4-inch artesian well, Columbia planter, cultivators, 2-way John Deere plow, sprayers, moving machine, dump rake, springtooth harrow, artesian well(Sanpete County), well for watering horses(Panguitch), well and equipment(Carbon County), potato digger, Ford truck(Carbon County), lath propagating house, cultipacker, beet puller, water-measuring devices, McCormick-Deering binder, John Deere hayrake, grain drill, weed cultivator, mower, 2-section harrow, self-binder.

²Purchased with funds provided by U. S. Bureau of Dairying for Project 73.

COOPERATIVE RESEARCH

In carrying out its agricultural research program during the past biennium, the Utah Station has maintained cooperative relations with the following agencies:

Federal—U. S. Department of Agriculture

1. Study of relation of conformation and anatomy of the dairy cow to her producing ability. (Bureau Dairy Industry)
2. Continuous use of proved sires to breed dairy cattle that will be pure in their inheritance for high milk and butterfat producing capacities. (Bureau Dairy Industry)
3. Cooperative work to conduct
 - a. General dairy cattle-breeding investigations
 - b. Investigations of dairy cattle-feeding and management problems peculiar to the region (Bureau Dairy Industry)
4. Diseases of vegetables and related plants: potato diseases (Bureau Plant Industry)
5. Development of uniform types of purelines of sugar-beets for testing resistance to curly-top. (Bureau Plant Industry)
6. Cereal improvement studies. (Bureau Plant Industry)
7. Sugar-beet breeding investigations. (Bureau Plant Industry)
8. Economic factors affecting the production and marketing of Utah's poultry products. (Bureau Agricultural Economics)
9. Sugar-beet leafhopper (life history, control, habits). (Bureau Entomology)
10. Feeding value of alfalfa hay treated with calcium arsenate for destroying injurious insects. (Bureau Entomology)
11. A study of some factors which influence the reclamation of water-logged and alkali lands. (Bureau Public Roads)
12. Relation of stream discharge to precipitation with special reference to forecasting the supply of water for irrigation from seasonal surveys of snow cover on mountain watersheds.
(No written agreement—informal only).
(Weather Bureau, Forest Service)
13. Utah flood and erosion survey.
(No written agreement—informal only).
(Forest Service, State Land Board)
14. Tomato Diseases in Utah—Fusarium Wilt, Bacterial Canker, Mosaic and Streak, Curly-top, and Psyllid Yellows. (Bureau Plant Industry)

Miscellaneous

1. The nutritive value of high vs. low calcium- and phosphorus-carrying wheat. (Department of Household Science, California University)
2. Use and effect of fertilizers on soils of state. (U.S.A.C. Extension Service)
3. Analysis of irrigation waters of state. (U.S.A.C. Extension Service)
4. A study of organization and management of Utah farms. (U.S.A.C. Extension Service)
5. Weed control. (State Department of Agriculture)
6. Alfalfa-seed production in Millard County. (State Department of Agriculture)
7. Virus diseases of the potato and factors influencing their development and control. (State Department of Agriculture)

8. The susceptibility of cattle to inoculations with acid-fast organisms isolated from so-called tubercular skin lesions.
(State Department of Bacteriology and Bureau of Animal Industry, U. S. Dept. Agr.)
9. Alfalfa-seed studies, Uintah Basin. (U. S. Indian Service)
10. Lamb-feeding experiments on winter dry-lot.
(Monroe and Delta Lamb Feeders Associations)
11. Methods of plant-growing and plant-growing structures.
(Utah Power and Light Company)
12. Corn and cottonseed cake as concentrated supplements for wintering sheep on desert ranges of Utah.
(Howells Company, Inc.)
13. The intermountain herbarium. (U.S.A.C. Botany Department)
14. Bacterial wilt studies. (Salt Lake County)
15. Grain survey. (Federal Farm Board)

For experimental farm cooperation with various counties, see pages 10-12, inclusive.

BOOKS PURCHASED BY STATION DEPARTMENTS²

The following list of 146 books, grouped by department, represents those books purchased by various Station departments on Station funds since July 1, 1929. These books have been accessioned in the Station Library and then returned to the respective departments for their immediate reference:

Agricultural Economics

- "American Cooperation"; 1927 (Vols. 1,2); 1928 (Vol. 1); 1929 (Vol. 1); 1930 (Vols. 1,2)—Pub. by American Institute of Cooperation
- "Barlow's Tables"—duplicate copies
- "Business Cycles", W. C. Mitchell
- "The Farm Board", E. A. Stokdyk and C. H. West
- "Introduction to the Study of Prices", W. T. Layton
- "Methods of Correlation Analysis", E. Mordecai
- "Mathematical Introduction to Economics", G. C. Evans
- "Practical Standard Dictionary", (Funk and Wagnalls)
- "The Smoothing of Time Series", F. R. Macaulay

Agronomy

- "Alfalfa", by J. F. Cox and C. R. Megee
- "German-English Technical and Scientific Dictionary", edited by A. Webel
- "Introduction to Agricultural Biochemistry", R. A. Dutcher and D. E. Haley
- "Land Drainage and Reclamation", Ayres and Scoates
- "Official and Tentative Methods of Analysis", (Association Official Agricultural Chemists)
- "Outlines of Biochemistry," R. A. Gortner
- "Physical Properties of the Soil", A. B. Keen
- "Plant Ecology," J. E. Weaver and F. E. Clements
- "The Plant in Relation to Water," N. A. Maximov
- "Principles of Soil Technology", P. Emerson
- "Principles of Plant Pathology," C. E. Owens
- "Seed Production and Marketing", J. F. Cox and G. E. Starr
- "Tables of Squares, Cubes, Square Roots, Cube Roots", etc., Barlow

²This list includes all books purchased on Station funds by various departments since July 1, 1929.

Animal Disease Laboratory

- "Anatomy of the Domestic Fowl", B. F. Kaupp
"Animal Parasites and Parasitic Diseases", B. F. Kaupp
"Diseases of Domesticated Birds", A. R. Ward and B. A. Gallagher
"Desk Standard Dictionary", Funk and Wagnalls
"Diseases Transmitted from Animals to Man", T. H. Hull
"Elementary Photographic Chemistry" (Eastman Kodak Company)
"Examination of the Urine of the Horse and Man", P. A. Fish
"Fundamentals of Photography" (Eastman Kodak Company)
"Guide to the Study of Animal Parasites", W. A. Riley and R. O. Christenson
"Heredity in Poultry", R. C. Punnett
"Hog Cholera: Its Nature and Control", R. R. Birch
"Laboratory Manual in General Microbiology", W. Giltner
"Laboratory Manual in General and Pathogenic Bacteriology and Immunity", V. A. Moore and W. A. Hagan
"Laboratory of Methods for Pure Culture Study of Bacteria", (Society of American Bacteriologists)
"Manual of Determinative Bacteriology", D. H. Bergey
"Manual of Poisonous Plants", L. H. Pammel
"Manual of Veterinary Bacteriology", R. A. Kelser
"Medical and Veterinary Entomology", W. B. Herms
"The Newer Knowledge of Bacteriology and Immunology", E. O. Jordan and I. S. Falk
"Parasites and Parasitosis of Domestic Animals", B. M. Underhill
"Parasites of Swine", M. C. Hall
"Pathogenic Microorganisms", W. A. Park, A. W. Williams, *et al.*
"Physiology of Reproduction in the Cow", J. Hammond
"Physiology and Biochemistry of Bacteria", B. E. Burnham and K. I. Fullmer
"Poultry Diseases", B. F. Kaupp
"Poultry Husbandry", M. A. Jull
"Poultry Practice" (Collection of articles)
"Practical Laboratory Methods and Histological Technic", E. Arthur
"Practical Bacteriology, Blood Work and Animal Parasitology", E. R. Stitt
"Practical Dairy Bacteriology", H. W. Conn
"Practical Veterinary Pharmacology, Materia Medica, and Therapeutics", H. J. Milks
"Principles of Animal Hygiene", L. Van Es
"Principles of Microbiology", V. A. Moore
"Principles of Pathologic Histology", F. B. Mallory
"Range Beef Production", F. S. Hultz
"Range Sheep and Wool" (in 17 western states), F. S. Hultz and J. A. Hill
"Rouse, Leucotic and Allied Tumors in the Fowl", J. P. McGowan
"Special Pathology and Therapeutics of Diseases of Domestic Animals, Vois. 1,2, and 3, F. Hutyra, J. Marck, *et al.*
"Sex Hygiene and Reproduction of Cattle", W. W. Williams
"Sheep Diseases", E. T. Baker
"Standard Methods", A. B. Wadsworth
"Standard Methods for Examination of Water and Sewage (American Public Health Association)
"Textbook of Bacteriology", W. W. Ford
"Textbook of Histology", O. S. Strong and A. Elwyn
"Textbook of Meat Hygiene", R. Edelman
"Turkeys", A. C. Smith (pamphlet)
"Vertebrate Embryology", W. Shumway
"Veterinary Bacteriology", R. E. Buchanan
"Veterinary Hygiene", M. Klimmer
"Veterinary Toxicology", G. E. Lander

- "Veterinarian's Handbook of Materia Medica and Therapeutics",
D. H. Udall

Bacteriology and Chemistry

- "Allen's Commercial Organic Analysis", C. A. Mitchell *et al.*
Vols. 7 and 8
"Commercial Organic Analysis" (5th Ed.), Vol. 9
"Compilation of Culture Media", M. Levine and H. W. Schoenlein,
Vol. 2
"Fixation of Atmospheric Nitrogen", F. A. Ernst
"Manual of Determinative Bacteriology", D. H. Bergey
"Practical Physiological Chemistry", P. B. Hawk and O. Bergeim
"Principles of Soil Microbiology", S. A. Waksman
"The Rat", H. H. Donaldson
"The Vitamins", H. C. Sherman and S. L. Smith

Botany and Plant Pathology

- "Artificial Sunlight", M. Luckiesch
"Chemical Investigation of Plants", L. Rosenthaler
"Chemical Plant Physiology", S. Kostychev
"German-English Technical and Scientific Dictionary, edited by A.
Webel
"Introduction to Laboratory Technique in Bacteriology", M.
Levine
"Laboratory Outline in Bacteriology and Immunology", J. F.
Norton and I. S. Falk
"Methods of Plant Histology", C. J. Chamberlain
"Official and Tentative Methods of Analysis" (Association Official
Agricultural Chemists)
"Use of the Microscope", J. Belling

Dairy Husbandry

- "Computer", F. J. Smith
"Tables of Squares, Cubes, Square Roots, Cube Roots, Reciprocals"
P. Barlow

Entomology

- "Buprestidae of North America", A. J. Chamberlin
"General Textbook of Entomology", A. D. Imms
"Heteroptera of Eastern North America", W. S. Blatchley
"History of Entomology", E. O. Essig
"Insects and Diseases of Man", Carroll Fox
"Insects of Western North America", E. O. Essig
"Insecticides, Fungicides, and Appliances", O. G. Anderson and
F. C. Roth
"Insect Pests of Farm, Garden, and Orchard", E. D. Sanderson and
L. M. Peairs
"Index III to Literature of American Economic Entomology, M.
Colcord
"Manual for Spraying", K. L. Cockerham
"Microtomist's Vade-Mecum", A. B. Lee
"Phylogenetic Method in Taxonomy", H. M. Hall and F. E. Clements
"Principles of Insect Control", R. A. Wardle and P. Buckle
"Problems of Applied Entomology", R. A. Wardle
"Recent Advances in Entomology", A. D. Imms
"Skelett, Muskulatur, and Darm der schwarzen Blattlaus, *Aphis
fabae* Scop" (1928), E. Weber
"Zoological Record, Vols. 55-62 (1915-25), 64 (1927). (Special Auer-
bach Fund)

Home Economics

- "Laboratory Handbook for Dietetics", M. S. Rose
"Physical Measures of Growth and Nutrition", R. Franzen
"Tables of Food Values", Alice V. Bradley

Horticulture

- "Annual Report(1924) East Malling Research Station, East Malling, Kent, England". (Paper bound)
 "Annual Report(1925) East Malling Research Station, East Malling, Kent, England". (Paper bound)
 "Annual Report(1927) East Malling Research Station, East Malling, Kent, England". (Paper bound)
 "Journal of Pomology and Horticultural Science", Vol.7 (Paper bound)
 "Official and Tentative Methods of Analysis" (Association of Official Agricultural Chemists)

Irrigation and Drainage and Soils

- "Dimensional Analysis", P. W. Bridgman
 "Statistical Mechanics with Applications to Physics and Chemistry", R. C. Tolman
 "Flood Flows", A. Hazen
 "Tables of Applied Mathematics in Finance, Insurance, Statistics," J. W. Glover
 "Physical Properties of the Soil", B. A. Keen
 "Bulletin of the National Research Council, No.84(February, 1932) Report of Committee on *Hydrodynamics*

Veterinary Science

- "Lead Poisoning", J. C. Aub, *et al.*
 "The Blood Picture", V. Schilling

LIBRARY

No. Bound Volumes on Shelves(as of 1 July 1932):

State Departments of Agriculture	446
Experiment Stations	1465
U. S. Department of Agriculture	1148
Department of Interior	607
Miscellaneous (Technical and Scientific Journals)	733
Smithsonian Institution (U. S. National Museum)	200
Bureau of Commerce	72
Library of Congress	34
Foreign	787

Total No. Bound Volumes in Station Library 5528

Total Bound Volumes in Various Departments
 Accessioned in Station Library 146

GRAND TOTAL BOOKS IN STATION LIBRARIES 5674

Technical Journals and Popular Magazines Received Regularly (Not including regular publications received from U. S. Department of Agriculture, U. S. Department of Interior, State Stations, etc.) 175

The special delivery service rendered to Station staff members, which was begun on January 7, 1931, continued throughout the present biennium until April 1, 1932, when it was temporarily discontinued, owing to lack of funds.

EXPERIMENTAL FARMS

Establishment and Location

During the biennium ending June 30, 1932, the Experiment Station has operated the following farms, established and located as indicated:

Name of Farm	Date of Establishment	Location	No. of Acres
Boxelder	1931	Boxelder County	40
Carbon	1927	Carbon County	40
Dairy (Cronquist)	1924	Cache County (1.5 miles north of campus)	86
Davis	1920	Davis County	23.5
Greenville	1901	Cache County (2 miles north of campus)	45.5
Nephi	1903	Juab County	103
Panguitch	1911	Garfield County	106
San Juan	1925	San Juan County	40
Sanpete	1927	Sanpete County	40
Uintah Basin	1925	Duchesne County	40
Washington	1931	Washington County	40
Widtsee	1917	Garfield	40

Experimental work is also conducted in Millard County, and although no definite experimental farm has been established a member of the Station staff is employed full-time to study the agricultural problems of that county, especially in regard to alfalfa-seed growing.

The Greenville, Davis, and Panguitch Farms are on property owned by the State. All of the remaining farms are on leased property. The Greenville and Dairy Farms are designated as central farms, being so close to the College Campus as to be regarded as part of it and thereby affording nearby field-laboratory facilities. The Davis Farm became State property through purchase in 1925 and is now operated as a regular part of the Experiment Station. The Panguitch Livestock Farm, formerly a federal Indian school, became State property in 1909 and two years later (1911) was designated by the Legislature as an experimental farm. Since then it has been operated out of general maintenance. The Nephi Farm, also, although on leased property, is operated out of the general maintenance funds of the Experiment Station. This has been true also of the Widtsee Farm which, through agreement with Garfield County, is to be discontinued at the close of the cropping season of 1932.

Five of the other farms (Sanpete, Uintah, Carbon, San Juan, and Millard) until 1931 were operated under special individual appropriations. The last Legislature lumped all of these appropriations with the item covering general maintenance of the Experiment Station, added \$5200 to the whole, and designated two additional farms: Washington and Boxelder.

Scope of Work

The scope of the work done on the experimental farms is indicated by the following summary:

Greenville—Irrigation, crop rotation, cereal breeding, soil fertility, sugar-beet culture, sugar-beet breeding, commercial fertilizers

Dairy (Cronquist)—Dairy farming, dairy cattle rations, comparisons of corn silage and beet pulp in dairy cattle rations, irrigated pasture studies, hog-fattening on alfalfa pasture

Davis—Horticultural investigations, including variety tests with tree fruits, small fruits, truck crops, onion breeding, onion storage, market garden practice, hotbed heating, canning crops improvement

- Panguitch**—Beef cattle breeding, pasture management, winter feeding of beef cattle, studies of effect of winter feed and shelter on fleece values of range ewes, relative market value of crossbred lambs, fleece and lamb comparisons with types B and C Rambouillet ewes, and general field-crop production studies
- Nephi**—Dry-farming, dry-land crop rotations, variety testing, cereal breeding, soil and soil-moisture studies, nitrate studies, general cultural practice comparisons, time and depth of plowing, rate and date of seeding, fallowing, continuous cropping
- Widtsoe** (7800 feet)—Dry-farming and use of early irrigation water at high altitude, variety testing, cultural practices, similar to Nephi but much more limited, owing to more erratic and less favorable climatic conditions. (To be discontinued at end of cropping season of 1932)
- Sanpete**—Muck land studies, on soil representative of about 25,000 acres in Utah, variety testing with field and truck crops, cultural practices, soil and soil-moisture relations, soil fertility, commercial fertilizers, winter-flooding
- Carbon**—Irrigation farm practice on soil types common in eastern Utah, field crop varieties, soil and soil-moisture studies, methods of irrigating, soil fertility, commercial fertilizers, cultural practices adapted to soil types
- Uintah Basin**—Alfalfa breeding, seed production practices under irrigation, seed-insect control, comparisons of other crops and methods adapted to Uintah Basin, forage crops, corn varieties, small grains
- San Juan**—Dry-farming practice, variety tests with all suitable crops, cultural practices, adapted to region comprising about 600,000 acres of potential farm land
- Millard**—No farm has actually been established here, but a representative of the Experiment Station is kept constantly on the job, co-operating with farmers in a close study of farm practice, irrigation methods, and general factors affecting crop production, especially alfalfa-seed production
- Boxelder**—Owing to limited supporting funds it has been impossible to make permanent set-up of farm, but much preliminary work has been done on a temporarily leased tract with orchard-management studies designed especially to help the stone-fruit industry. Another and more favorable site for farm work in this field of investigation has been suggested.
- Washington**—The same financial problem as that affecting Boxelder has limited work on the Washington Farm, but, owing to a favorable working relationship with a federal agency, it has been possible to make greater progress. A small tract of land is being used for tests with tree fruits, market garden crops, tomato breeding, and orchard heating.

Status of Farms

The policy of the Experiment Station in the operation of the experimental farms has been defined by a two-fold interest: (1) To make them render the greatest possible service to the agricultural areas directly represented by them and (2) to utilize them as field laboratories, affording facilities for fundamental research designed to extend general knowledge of crop and animal production. Thus, while the experiments on each farm aim at solving farm problems common to its respective locality, these same experiments are so planned as to yield data of importance to all parts of the state.

It is apparent that agricultural research requires laboratory facili-

ties, and that there are several different types of laboratories. There is the conventional type, that is, the chemical, physical, or biological type, involving indoor housing, desks, hoods, incubators, test tubes, microscopes, etc. Then there is the greenhouse laboratory, or the feed-lot laboratory. Another type is the open field, forest, or range. Still another is the snow drifts, or the eroded canyon, or the farm home.

Obviously, if crop and animal production problems are to be studied under controlled conditions. It is necessary to have laboratory facilities available in those sections where soil type, climate, and other physical factors related to those problems can be studied. The experimental farm satisfies those requirements, and it is as field laboratories that the Experiment Station operates them.

Operated under this general policy, the farms in years gone by have yielded data of unquestionable importance to the agriculture of Utah. The dry-farm at Nephi, for example, established in 1903, for nearly 30 years has served as a source of dependable information to dry-farmers. It was largely through the work of that farm that hard red winter wheat came to be the common dry-farm wheat of this state. The time-of-plowing tests conducted there have virtually established general plowing practice on the dry-lands of Utah; and, among other work done at Nephi, the present nitrate studies promise to be of equal service in the future. The gross good resulting from any of several tests conducted during the last quarter-century would more than justify the total expense of the farm, many times over.

Similarly, the irrigation, rotation, and soil fertility work of the Greenville Farm, the dairy-farming investigations on the Cronquist Farm, the truck-crop studies at Davis, muck-land investigations at Sanpete, alfalfa-seed and alfalfa-breeding work at the Uintah Basin and in Millard County, irrigation farm studies at Carbon, dry-farming at San Juan, and livestock at Panguitch have all proved highly beneficial. It is believed, also, that the work at Washington and Boxelder will prove equally beneficial to fruit and truck growers if this work is permitted to grow as that of the other farms has grown since establishment.

At present, the work of all the farms is believed to be contributing substantially to a solution of the major problems each is expected to attack. It is believed, also, that the results so far obtained justify the money spent in the operation of the farms.

PUBLICATIONS

General Statement

Fifteen bulletins (Nos. 220-234, inclusive) and eleven circulars (Nos. 88 to 99, inclusive) have been edited and prepared for publication by the Editorial and Publications Division during the past biennium. In addition to the regular Station series of bulletins and circulars: Miscellaneous Publications Nos. 8 and 9 have also been edited and published as well as fifty-one reprints of technical articles (Nos. 151 to 201, inclusive) which have appeared in various scientific publications. Mimeograph Sheets Nos. 50 to 63, inclusive, which are designed to supply a demand for more popular information than the Station circular series, have also appeared during this biennium.

At the end of each fiscal year an annual summary of publications is issued by this division in which is given a brief abstract of each bulletin, circular, and reprint as well as Miscellaneous Publications which appear only occasionally. These annual summaries are sent to

the entire mailing list of some 10,000 names in July of each year. However, all libraries, editors, and Utah county agricultural agents, county agricultural inspectors, vocational agricultural instructors, and one or two other special lists receive each publication as it is released from the press. Circular 95 summarizes Bulletins 220 to 230, inclusive; Circulars 88 to 94, inclusive, Reprints 151-170, inclusive, and Miscellaneous Publication 8. Circular 100 will summarize all publications of these same series which have been issued since July 1, 1931.

Publications Issued with Federal Funds³

During the past biennium the following bulletins, circulars, reprints of technical articles, and miscellaneous publications have been issued under various Station projects supported by Purnell, Adams, and Hatch Funds:

Purnell Fund

Bulletins: Nos. 227, 231, 233, 234

Circulars: Nos. 91, 99

Reprints: Nos. 151, 152, 161, 169, 170, 171, 172, 173, 175, 176, 177, 178, 180, 184, 188, 191, 192, 198, 200, 201

Miscellaneous Publications: Nos. 8, 9

Adams Fund

Reprints: Nos. 153, 158, 163, 174, 179, 193, 194, 195

Hatch Fund

Bulletins: Nos. 221, 223

Reprints: Nos. 154, 157, 159, 162, 166

Detailed Statement of Publications

Following is given a comprehensive, concise statement of publications issued during the past biennium:

³For complete reference, see pages 14-21, inclusive.

Publications Issued by Utah Agricultural Experiment Station during Biennium ending June 30, 1932
BULLETINS

14

No.	Title	Author or Authors	No. Ordered	No. Pages	Total Pages	Cost Data		
						Printing	Engraving	Total
220	Biennial Report of Utah Agricultural Experiment Station, July 1, 1928 to June 30, 1930	P. V. Cardon	3000	64	192,000	\$ 300.00	\$ 28.73	\$ 328.73
221	Snakes of Utah	H. J. Pack G. F. Knowlton	2500	32	80,000	148.00	30.15	178.15
222	A Quarter Century of Dry-Farm Experiments at Nephi, Utah	A. F. Bracken George Stewart	3500	42	147,000	381.00	22.61	403.61
223	Feeding Value of Alfalfa Hay Treated with Calcium Arsenate	H. J. Frederick	3500	8	28,000	42.00	14.72	56.72
224	Muck Soil Investigations	LeMoyne Wilson George Stewart	3500	42	147,000	381.00	22.61	403.61
225	Progress Report, Carbon County Experimental Farm, 1927-30, inclusive	I. D. Zobell George Stewart	2500	20	50,000	100.00	20.00	120.00
226	Alfalfa-Seed Production	J. W. Carlson George Stewart	3500	56	196,000	256.00	27.05	283.05
227	Soft-Curd Milk	R. L. Hill	5300	24	127,200	147.70	39.45	187.15
228	Twenty Years of Rotation and Manuring Experiments at Logan, Utah	George Stewart D. W. Pittman	4000	32	128,000	161.50	3.70	165.20
229	Production Study of 160 Dairy Herds, Wellsville, Utah, 1929	G. Q. Bateman	3000	16	48,000	61.00	13.60	74.60
230	Progress Report of San Juan County Experimental Dry-Farm	James H. Eagar A. F. Bracken	2500	16	40,000	59.00	10.68	69.68
231	Snow-melting Characteristics (Tech.)	G. D. Clyde	3500	48	168,000	179.00	62.72	241.72
232	Family Living Expenditures in Summit County, Utah, 1930	Edith Hayball W. P. Thomas	3000	32	96,000	97.25	29.35	126.60
233	Observations on the Use of Commercial Fertilizers on the Arid Soils of Utah	D. W. Pittman C. Burnham ⁵	4000	24	96,000	129.75	11.90	141.65
234	Studies on the Beet Leafhopper in Northern Utah, (Tech.)	G. F. Knowlton	3500	64	224,000	257.75	55.24 ⁶	312.99
Total Cost of Bulletins 220-234, inclusive						\$2179.16	\$339.35	\$2518.51

BULLETIN No. 235

⁴Cost of publication paid for by Projects 96, 97, and 100, respectively.

⁵Graduate student, Department of Agronomy.

⁶\$35 of this amount was paid for by Project 82.

Circulars

No.	Title	Author or Authors	No. Ordered	No. Pages	Total Pages	Cost Data		
						Printing	Engraving	Total
88	Annual Summary of Publications ..	B. C. Pittman	10,000	8	80,000	\$148.00	\$	\$148.00
89	Rules and Regulations for the Seventh Utah Intermountain Egg-laying Contest	Byron Alder	2,000	4	8,000	32.00	.....	32.00
90	Swine Production in Utah	Harry H. Smith	5,000	28	140,000	165.20	29.40	194.60
91	Establishing Snow Courses and Making Snow Surveys	G. D. Clyde	2,500	16	40,000	65.80	26.34	92.14
92	Torrential Floods in Northern Utah, 1930	S. Q. Cannon <i>et al.</i>	4,000	52	208,000	326.02	72.78	398.80
93	Better Sugar-beet Culture for Utah	G. Stewart D. W. Pittman	5,000	32	160,000	180.00	11.65	191.65
94	Control and Eradication of Bang's Abortion Disease ⁷	D. E. Madsen W.H.Hendricks	5,000	8	40,000	51.20	3.50	54.70
95	Annual Summary of Publications July 1, 1930 to June 30, 1931)	B. C. Pittman	10,000	16	160,000	160.00	.....	160.00
96	Crickets and Grasshoppers in Utah	W. W. Henderson	5,000	40	200,000	189.00	16.00 ⁸	366.60
97	Growing Alfalfa-seed ⁹	J. W. Carlson	4,000	20	80,000	85.00	24.94	109.94
98	Insects in Relation to Alfalfa-seed Production ¹⁰	C. J. Sorenson	4,000	28	192,000	98.40	24.35	122.75
99	Utah Snow Sampler and Scales for Measuring Water Content of Snow	G. D. Clyde	3,000	12	36,000	28.00	22.30	50.30
Total Cost of Circulars, 88 to 99, inclusive						\$1528.62	\$392.86	\$1921.48

⁷Paid for by Animal Disease Laboratory.

⁸For drawing of cover cut.

^{9,10}Paid for by Projects 75 and 51-B, respectively.

Technical Articles (Reprints)

Reprint No.	Title, Author or Authors, and Source of Publication	No. Ordered	Cost Data		
			Printing	Cuts	Total
151	Effect of Physical Curd Character of Milk on the Quality, Yield, and Physical Texture of Cheese. By R. L. Hill and A. C. Merrill ¹¹ . In PROCEEDINGS, Utah Acad. Sciences, 7 (July 15, 1930): 62-63	300	\$ 5.05	\$	\$ 5.05
152	Studies on the Beet Leafhopper. By G. F. Knowlton. In PROCEEDINGS, Utah Acad. Sciences, 7 (July 15, 1930): 57-58	100	3.75	.....	3.75
153	Effect of Replaceable Sodium on the Physical Character of Alkali Soils. By Willard Gardner and Evan Harris ¹² . In PROCEEDINGS, Utah Acad. Sciences, 7 (July 15, 1930): 50-51.	100	3.70	.....	3.70
154	The "Spitting" Habit of Lepidopterous Larvae. By H. J. Pack. Compiled by G. F. Knowlton. In JOUR. ECON. ENT., 23 (August, 1930): 736-738	250	5.00	.....	5.00
155	Relation of Type of Topping to Storage Losses in Sugar-beets. By C. M. Tompkins and S. B. Nuckols ¹³ . In PHYTOPATH., 20 (August, 1930): 621-635	250	8.45	.....	8.45
156	Artificial Tripping of Flowers in Alfalfa in Relation to Seed Production. By J. W. Carlson. In JOUR. AMER. SOC. AGRON., 22 (September, 1930): 780-786	250	10.18	.....	10.18
157	Notes on Utah Lachnea (Aphididae). By G. F. Knowlton. In CANAD. ENTOM., 62 (July, 1930): 152-161	250	19.01	4.32	23.33
158	The Microflora of Leached Alkali Soil. By J. E. Greaves and J. Dudley Greaves ¹⁴ . In BOTANICAL GAZETTE, 90 (October, 1930): 224-229	300	7.65	.....	7.65
159	Notes on Utah Hemiptera. By H. J. Pack and G. F. Knowlton. In CANAD. ENTOM., 62 (November, 1930): 248-250	250	8.02	.....	8.02
160	A Mathematical Study of the Decrease of Crop Yields. By J. Dudley Greaves. In SOIL SCIENCE: 31 (February, 1931): 115-127	300	6.90	.....	6.90

¹¹Assistant Professor of Dairying, Utah State Agricultural College.¹²Graduate Student. Departments of Physics, Soils, and Irrigation and Drainage.¹³Former Assistant Plant Pathologist and Associate Agronomist, Office of Sugar Plants, Bureau Plant Industry, U. S. Department of Agriculture, respectively.¹⁴Graduate student, Department of Chemistry and Bacteriology.

Technical Articles (Reprints)

Reprint No.	Title, Author or Authors, and Source of Publication	No. Ordered	Cost Data		
			Printing	Cuts	Total
161	A New Spring Balance for Measuring Water Content of Snow. By G. D. Clyde. In SCIENCE, 73 (February, 1931), No. 1885: 189	250	3.87	.....	3.87
162	Notes on Utah Heteroptera and Homoptera. By G. F. Knowlton. In ENTOM. NEWS, 42 (February-March, 1931): 40-43; 68-72	250	19.21	.....	19.21
163	The Microflora of a Rich Sulphate-Containing Soil. By J. Dudley Greaves. In JOUR. AGR. RSCH., 42 (February, 1931): 183-186	250	1.50	.....	1.50
164	The Late Blight Disease of the Sugar-beet. By B. L. Richards and C. M. Tompkins ¹⁵ In PHYTOPATH., 21 (March, 1931): 289-314	350	25.75	.....	25.75
165	A Quarter Century of Dry-farm Experiments. By A. F. Bracken and G. Stewart. In JOUR. AMER. SOC. AGRON., 23 (April, 1931): 271-279	200	13.00	.....	13.00
166	The Wheat Strawworm, <i>Harmolita grandis</i> Riley, in Utah, 1930. By G. F. Knowlton. In JOUR. ECON. ENTOM., 24 (April, 1931): 414-416	300	6.00	.....	6.00
167	Some Facts concerning Potato Storage in New York. By E. V. Hardenburg ¹⁶ and A. L. Wilson. In PROCEEDINGS 16th Annual Meeting of Potato Association of America (December, 1929): 168-177	None	.....	.....	---
168	Hydrogen-ion Concentration in Relation to the Growth of Onions. By A. L. Wilson. In PROCEEDINGS American Society for Horticultural Science, 1930: 524-528	None	.....	.....	.....
169	Inheritance in a Wheat Cross between Hybrid 128 x White Odessa and Kanred. By G. Stewart and R. W. Woodward ¹⁷ . In JOUR. AGR. RSCH., 42 (April, 1931): 507-520	300	4.35	.....	4.35
170	Inheritance of Awns in a Kota x Hard Federation Cross. By G. Stewart and B. Ira Judd ¹⁸ . In JOUR. AMER. SOC. AGRON., 23 (June, 1931): 455-464	250	17.00	.....	17.00
171	Relationship between Precipitation in Valleys and on Adjoining Mountains in Northern Utah. By G. D. Clyde. In MO. WEATH. REV., 59 (March, 1931): 113-117	300	3.75	.....	3.75

¹⁵Former Assistant Plant Pathologist, Bureau Plant Industry, U. S. Department of Agriculture.

¹⁶Professor of Vegetable Crops, Cornell University.

^{17,18}Graduate students, Department of Agronomy.

Technical Articles (Reprints)

Reprint No.	Title, Author or Authors, and Source of Publication	No. Ordered	Cost Data		
			Printing	Cuts	Total
172	There is a Difference in Milk Curd. By R. L. Hill. In BUL. AGR. COM. AMER. BANK ASSOC., 5: 2-3 (July, 1931)	200	.....	.....	(Gratis)
173	Studies on the Biology of <i>Paratrioza cockerelli</i> (Sulc). By G. F. Knowlton and M. J. Janes ¹⁹ In ANNALS, Ent. Soc. Amer., 24: 283-291 (June, 1931)	300	7.30	16.39	23.69
174	Ammonification of Nitrogenous Substances by Pure Cultures of Microorganisms. By H. C. Pulley ²⁰ In JOUR. AGR. RSCH., 42: 791 800 (June, 1931)	150	1.50	.....	1.50
175	Correlated Inheritance in a Cross (Sevier x Dicklow) x Dicklow Wheats. By G. Stewart and R. K. Bischoff ²¹ In JOUR. AGR. RSCH., 42: 775-790 (June, 1931)	200	2.50	.....	2.50
176	Inheritance of Dwarfing in Wheat. By D. C. Tingey. In PROCEED- INGS, Utah Acad. Sci., 8: 59-60 (July, 1931)	100	5.00	.....	5.00
177	Diet as in Index of Living Level in Some Utah Farm Homes. By Almeda P. Brown. In PROCEED- INGS, Utah Acad. Sci., 8: 111-114 (July, 1931)	250	11.50	.....	11.50
178	Bacterial Canker of Tomato. By H. L. Blood. In PROCEEDINGS, Utah Acad. Sci., 8: 55-58 (July, 1931) ..	250	11.50	3.50	15.00
179	Drainage of Land Overlying an Artesian Basin. By O. W. Israel- sen. In PROCEEDINGS, Utah Acad. Sci., 8: 35-37 (July, 1931) ..	250	9.50	.....	9.50
180	Efficiencies in Irrigation. By O. W. Israelsen. In PROCEEDINGS, Utah Acad. Sci., 8: 40-43 (July, 1931)	250	13.50	.....	13.50
181	Notes on Some Beneficial Utah Diptera. By G. F. Knowlton and M. J. Janes. In PROCEEDINGS, Utah Acad. Sci., 8: 147-148 (July, 1931)	200	6.00	.....	6.00
182	Notes on Insect Food of Two Utah Lizards. By G. F. Knowlton and M. J. Janes. In PROCEEDINGS, Utah Acad. Sci., 8: 140-142 (July, 1931)	250	9.50	.....	9.50

¹⁹Graduate Student, Department of Entomology.²⁰Former Assistant Station Bacteriologist; resigned July 1 1931.²¹Former Station Agronomist and Graduate student, respectively.

Technical Articles (Reprints)

Reprint No.	Title, Author or Authors, and Source of Publication	No. Ordered	Cost Data		
			Printing	Cuts	Total
183	Some Economic Insects of Utah, 1930. By G. F. Knowlton. In PROCEEDINGS, Utah Acad. Sci., 8: 143-146 (July, 1931)	250	5.00	.....	6.00
184	Soft-curd Milk: Nature's Food for Infants. By R. L. Hill. In ARCHIVES OF PEDIATRICS, 48: 417-425 (July, 1931)	300	21.00	.....	21.00
185	Notes on the Biology of <i>Microbraccon hebetor</i> (Say). By G. F. Knowlton. In PROCEEDINGS Utah Acad. Sci., 8: 149-150 (July, 1931)		2.00 ²²	.....	2.00
186	Notes on Utah Diptera. By G. F. Knowlton. In CANAD. ENTOM., 68: 152-157 (July, 1931)	250	13.00	.....	13.00
187	Inbreeding in Alfalfa Establishes a High Degree of Homozygosity. By G. Stewart. In Science, 74: 341-343 (October 2, 1931)	250	8.53	.....	8.53
188	Correlated Inheritance in a Cross between Dicklow x Sevier Wheat. By G. Stewart. In JOUR. AMER. SOC. AGRON., 23: 918-928 (Nov. 1931)	250	17.00	.....	17.00
189	The Relation of Economic Research Work to Other Research in the State. By P. V. Cardon. In JOUR. FARM ECON., 13: 612-620 (Oct. 1931)	200	7.75	.....	7.75
190	Disease: Its Cause and Prevention. By J. E. Greaves. In SCIENTIFIC MO., 33: 428-433 (Nov. 1931) .....			.....
191	Soft-curd or Baby's Milk. By R. L. Hill. In GUERNSEY BREEDERS JOUR., 40: 670-671 (Dec. 1931)	200	.....	.....	(Gratis)
192	Inheritance in a Wheat Cross between Redit and a Segregate of Federation x Sevier (14-85). By G. Stewart. In JOUR. AMER. SOC. AGRON., 23: 964-976 (Dec. 1931)	250	17.00	.....	12.70
193	Effect of Replaceable Sodium on Soil Permeability. By A. Evan Harris ²³ . In SOIL SCI., 32: 445-446 (Dec. 1931)	300	10.40	.....	10.40
194	Coordination of Research concerning the Flow of Water in Soils. By O. W. Israelsen. In AGR. ENGIN., 12: 435-438 (Dec. 1931)	250	12.70	.....	12.70

²²None ordered, although a charge of \$2 was made for the second page (1st page, gratis).

²³Graduate student, Department of Physics.

Technical Articles (Reprints)

Reprint No.	Title, Author or Authors, and Source of Publication	No. Ordered	Cost Data		
			Printing	Cuts	Total
195	The Soil versus the Solution Method as a Means of Studying Bacterial Activities in Soil. By J. E. Greaves, and H. C. Pulley. In JOUR. AGR. RSCH., 43: 905-917 (Nov. 1931)	150	1.10	.....	1.10
196	Notes on Utah Coleoptera. By G. F. Knowlton. In FLORIDA ENTOM., 14: 36-37, 53-56, 75-77; 15: 10 (June, Sept., Dec. 1930; Apr. 1931)	250	8.89	.....	8.89
197	The Quality of Alfalfa-seed as Affected by Color and Plumpness. By G. Stewart and J. W. Carlson. In JOUR. AMER. SOC. AGRON., 24: 146-155 (Feb. 1932)	250	11.00	.....	11.00
198	Methods of Alleviating Water Shortages on Irrigation Projects By G. D. Clyde. In AGRIC. ENGIN 13: 37-41 (Feb. 1932)	200	23.40	.....	23.40
199	Outlook for the Sweet Cherry. By F. M. Coe. In BETTER FRUIT, 26: 5-6 (March, 1932)	200	4.50	.....	4.50
200	Some Effects of Wounding Onion Bulbs on Seed Production. By A. L. Wilson. In PROCEEDINGS, Amer. Soc. Hort. Sci.: 336-341 (1931)	200	10.23	.....	10.23
201	Recurrence of a Peculiar Genetic Recombination in the Spike Density of Wheat. By G. Stewart and L. W. Nelson ²⁴ . In AMER. NATURALIST, 6: 207-222 (May, June, 1932)	300	14.00	.....	14.00
Total Cost of Reprints Nos. 151-201, inclusive			\$434.44	\$ 24.21	\$458.65

Miscellaneous Publications

No.	Title	Authors or Authors	No. Ord.	No. Pages	Total Pages	Cost Data		
						Printing	Cuts	Total
8	Preliminary Report on Economic Factors Affecting the Production and Marketing of Poultry Products in Utah (October 1, 1928 to September 30, 1929)	W. P. Thomas, Marion Clawson	25	1000	24	24,000	\$112.00	\$ 7.02 \$119.02
9	Second Preliminary Report on Economic Factors Affecting Production and Marketing of Poultry Products in Utah	W. P. Thomas, Marion Clawson	1000	24	24,000	73.59	13.66	87.25
						\$185.59	\$20.68	\$206.27

²⁴Graduate student, Department of Agronomy.²⁵Assistant Agricultural Economist, Division of Farm Management and Costs, Bureau Agricultural Economics, U. S. Department of Agriculture.

SUMMARY OF COST DATA FOR PUBLICATIONS, 1930-32

	Printing	Cuts	TOTAL
Bulletins (Nos. 220-234, inclusive)	\$2179.16	\$339.35	\$2518.51
Circulars (Nos. 88-99, inclusive)	1528.62	392.86	1921.48
Technical Articles, Reprints (Nos. 151-201, inclusive)	434.44	24.21	458.65
Miscellaneous Publications (Nos. 8 and 9)	185.59	20.68	206.27
GRAND TOTAL	\$4327.81	\$777.10	\$5104.91

The following brief cost statement represents the amounts paid for by the departments concerned under specific projects for publications issued, the cost item of each being included in the aggregate amount specified above:

Dept.	Project No.	Series and No.	Printing	Cuts	TOTAL
Agronomy	96	Bulletin 224	\$ 146.25	\$ 21.25	\$ 167.50
Agronomy	97	Bulletin 225	100.00	20.00	120.00
Agronomy	75	Bulletin 226	256.00	27.05	283.05
Entomology	82	Bulletin 234	.....	35.00	35.00
Animal Disease	114	Circular 94	51.20	3.50	54.70
Agronomy	75	Circular 97	85.00	24.94	109.94
Entomology	51-B	Circular 98	98.40	24.35	122.75
TOTAL PAID BY OTHER FUNDS			\$ 736.85	\$156.09	\$ 892.94

These respective amounts for printing and cuts when deducted from the GRAND TOTAL (listed above) for the biennium ending June 30, 1932 will leave the following balance which was paid for from the budget of the Editorial and Publications Division:

Printing	\$4327.81	less	\$736.85 =	\$3590.96
Cuts	777.10	less	156.09 =	621.01
GRAND TOTAL	\$5104.91	less	\$892.94 =	\$4211.97

PROJECTS**New Projects**

Since July 1, 1930 several new projects have been launched and several projects which had been begun earlier but which had never been definitely approved as projects have been given specific numbers and included in the regular project list. These are:

No.	Title	Date of Beginning	Leader or Leaders	Department or Departments
State Fund				
112	Alfalfa-seed Investigations in Millard County.....	1929	George Whorn-ham	Agronomy
113	Types of Greens or Pot Plants Used in Utah Homes	1930	A. P. Brown	Home Economics

No.	Title	Date of Beginning	Leader or Leaders	Department or Departments
State Fund (Cont.)				
114	Studies of Cattle Affected with Bang's Disease.....	1930	D. E. Madsen	Animal Disease Laboratory
115	Bunt Control (a) Agronomic Phase (b) Pathological Phase....	1930	D. C. Tingey B. L. Richards	Agronomy Botany
116	Family Living Expenditures on Utah Farm Homes	1931	Edith Hayball W. P. Thomas	Agricultural Economics
117	Transmissibility of Bang's Disease among Dairy Cattle in a Utah Dairy Village	1931	D. E. Madsen	Animal Disease Laboratory
119	Boxelder County Experimental Farm	1931	F. M. Coe L. M. Winsor ²⁶	Horticulture Irrigation and Drainage
120	Washington County Experimental Farm	1931	F. M. Coe A. L. Wilson H. L. Blood	Horticulture Botany and Plant Pathology
121	Studies on Fowlpox.....	1931	D. E. Madsen	Animal Disease Laboratory
123	Improvement of Sweet Spanish Onions	1931	A. L. Wilson	Horticulture
124	Use of Plant Protectors and Paper Mulch in Vegetable Production	1931	A. L. Wilson	Horticulture
125	The Susceptibility of Cattle to Inoculations with Acid-fast Organisms Isolated from so-called Tubercular Skin Lesions		D. E. Madsen	Animal Disease Laboratory
127	Miscellaneous Onion Studies	Sept. 1931	A. L. Wilson	Horticulture
129	Variety Tests of Small Fruits	Oct. 1931	A. L. Wilson	Horticulture
130 ²⁷	Methods of Planting and Plant-growing Structures	Oct. 1931	A. L. Wilson	Horticulture
131	Effect of Dried Molasses Beet Pulp Added to a Standard Grain Mixture in Milk Production	Dec. 1931	G. B. Caine G. Q. Bateman	Dairy Husbandry

²⁶Irrigation Engineer, Bureau Agricultural Engineering, U. S. Department of Agriculture.

²⁷Cooperative with Utah Power and Light Company.

No.	Title	Date of Beginning	Leader or Leaders	Department or Departments
State Fund (Cont.)				
132 ²⁸	Corn and Cottonseed Cake as Concentrated Supplements for Wintering Sheep on Desert Ranges of Utah	Dec. 1931	E. J. Maynard A. C. Esplin R. J. Becraft J. E. Greaves	Animal Husbandry Range Management Chemistry
133	Cattle Feeding Experiments	Jan. 1932	E. J. Maynard J. E. Greaves	Animal Husbandry Chemistry
134 ²⁹	A Study of Organization and Management of Utah Farms	May 1932	W. P. Thomas	Agricultural Economics
135	The Intermountain Herbarium	1931	B. Maguire B. L. Richards	Botany
137	Miscellaneous Fertilizer Trials	1926 ³⁰	D. W. Pittman	Agronomy
140	Animal Disease Laboratory	1929 ³¹	D. E. Madsen	Animal Disease Laboratory
Purnell Fund				
118	Study of Factors Promoting Positive Health in Rural School Children	July 1931	A. P. Brown	Home Economics
122	Factors Influencing Marketability of Onions.....	Sept. 1931	A. L. Wilson	Horticulture
126	Factors underlying the Formation of Double Onions and Scallions.....	Sept. 1931	A. L. Wilson	Horticulture
128	Bacterial Wilt of Alfalfa	Nov. 1931	B. L. Richards R. J. Evans	Botany and Agronomy
141	Curly-top and Psyllid Yellows of the Tomato	July 1 1931	H. L. Blood F. B. Wann	Botany and Plant Pathology

Project Transfers by Funds

For obvious reasons it was desirable to make certain transfers of projects to other funds. Accordingly, beginning July 1, 1930, the following transfers have been made:

Project 78—Injurious Effects of Livestock of Sugar-beets and Their By-products
(From Purnell to Hatch)

Project 87—Miscellaneous Investigations in Veterinary Science
(From State to Hatch)

Project 106—Effect of Physical Curd Character of Milk on the Quality, Yield, and Physical Texture of Cheese
(From Hatch to Purnell)

²⁸Project 132 in cooperation with Howells Company, Inc. of Salt Lake City.

²⁹Cooperative with U.S.A.C. Extension Service.

^{30,31}Given regular project numbers on June 14, 1932.

Project Revisions

- Date of Authorization**
- 57—Poultry Feeding Experiments**
- A. Methods of Feeding Grain to the Laying Flock
 - B. Soft White Wheat vs. Hard Red Wheat as a Feed for Leghorn Hens and Pullets
 - C. All-night Light vs. Morning Light for Leghorn Hens and Pullets **January 16, 1932**
- 59—Davis Farm**
(To include investigations with vegetables and small fruits not included in separate projects) **September 16, 1932**
- 73—Production Studies in Dairying**
- A. A Standard Method of Management of All Daughters to Proved Sires
 - B. A Study of Individual Lactation Periods with Holstein Cows to Determine What Production Can be Expected on Three Different Home-grown Rations **January 16, 1932**
- 89—Nature and Cause of Chlorosis in Utah and Practical Methods of Control**
- A. Treatments of Chlorotic Plants
 - B. Soil Studies
 - C. Biochemical Studies
 - D. Economic Aspects
 - E. Development of Chlorosis-resistant Varieties of Small Fruits **November 5, 1931**
- 97—Carbon County Farm**
- A. Drainage and Reclamation of Alkali Spots
 - B. Irrigation and Erosion Studies of Carbon County Soils **July 30, 1931**

Projects Closed

During the past biennium the following projects have either been officially closed or will be held in abeyance for the time being:

- Project 3—Irrigation Practice** **Date of Closing**
Bulletin 219, June 1930 **July 1, 1931**
- Project 4—Soil Moisture Studies in Tanks of Cropped Soil.** Bulletin 219, June 1930 **July 1, 1931**
- Project 99-B—Fattening Lambs in Winter Drylot at Delta, Utah** **June 30, 1931**
- Project 74—Egg-laying Contest** **November 1, 1931**
- Project 102—Food Habits of Elementary Rural School Children in Relation to Their Physical Well-being** **July 1, 1931**
- Project 110—Feeding Value of Alfalfa Hay Treated with Calcium Arsenate for Destroying Injurious Insects**
Bulletin 223, December 1930 **July 1, 1931**

Project Statement

A brief, comprehensive statement of projects carried by fund, department, leader or leaders, etc. for the past biennium follows:

No.	Title	Date of Beginning	Leader or Leaders	Department or Departments
Hatch Fund				
24	Composition of Irrigation Waters of Intermountain Region	1916	J. E. Greaves C. T. Hirst	Chemistry and Bacteriology
51 ³²	Miscellaneous Insects			
	A. Wheat Jointworms. Codling Moth, and Boxelder Bug	1930	G. F. Knowlton	Entomology
	B. Insects in Relation to Alfalfa-seed Production	1930	C. J. Sorenson	Entomology
57 ³³	Poultry Breeding	1920	B. Alder	Animal Hus. (Poultry)
78	Injurious Effects on Livestock of Sugar-beets and Their By-products	1925	H. J. Frederick	Animal Hus. (Vet.Science)
87	Miscellaneous Investigations in Veterinary Science.....	1925	H. J. Frederick	Animal Hus. (Vet.Science)
93	Orchard Rootstocks	1928	F. M. Coe	Horticulture
95 ³⁴	Variety Testing	1928	F. M. Coe	Horticulture
110	Feeding Value of Alfalfa Hay Treated with Calcium Arsenate for Destroying Injurious Insects	1930	H. J. Frederick	Animal Hus. (Vet.Science)
Adams Fund				
12 ³⁵	Technical Studies of the Physical and Physico-chemical Properties and Processes in Soil.....	1912	D. S. Jennings W. Gardner O. W. Israelsen	Soils Physics Irrigation and Drainage
17	A Study of Some Factors Which Influence the Reclamation of Water-logged and Alkali Soils.....	1917	O. W. Israelsen W. Gardner D. S. Jennings	Irrigation and Drainage Physics Soils
22	Factors Influencing the Bacterial Activities of the Soil	1912	J. E. Greaves C. T. Hirst K. R. Stevens	Chemistry and Bacteriology
23	Permanent Fertility Studies	1916	J. E. Greaves	Chemistry and Bacteriology
31	Virus Diseases of the Potato and Factors Influencing Their Development and Control	1914	B. L. Richards	Botany and Plant Pathology
Purnell Fund				
25	Study of Underground Water	1915	Wm. Peterson	Geology

³²Project revised in 1931; formerly established in 1919.

³³Revised, January 16, 1932.

^{34,35}Projects 12 and 95 also carried on State Funds.

No.	Title	Date of Beginning	Leader or Leaders	Department or Departments
Purnell Fund (Cont.)				
33 ³⁶	Tomato Diseases in Utah— Fusarium Wilt and Bacterial Canker	1916	H. L. Blood F. B. Wann	Botany and Plant Pathology
61	Range Reseeding Studies with Native Forage Plants	1921	R. J. Becraft	Range Management
62	The Genetics of Spike Density, Awning Resistance to Bunt and Black Stem Rust and Other Characters in Wheat	1920	D. C. Tingey A. F. Bracken	Agronomy
72	Relationship of Stream Discharge to Precipitation with Special Reference to Forecasting the Supply of Water for Irrigation from Seasonal Surveys of Snow Cover on Mountain Watersheds	1923	G. D. Clyde	Irrigation and Drainage Engineering
77	Effect of Winter Feed and Shelter vs. Open-range Wintering on the Quality and Quantity of Wool from Utah Range Ewes.....	1925	A. C. Esplin	Animal Husbandry
80	Chalcis-fly in Alfalfa-seed..	1925	C. J. Sorenson	Entomology
82	Beet Leafhopper Investigations	1925	G. F. Knowlton	Entomology
84	Pasture Studies with Beef Cattle	1927	E. J. Maynard	Animal Husbandry
88	Studies of Utah Towns and Villages	1927	J. A. Geddes	Rural Sociology
89 ³⁷	Nature and Cause of Chlorosis in Utah and Practical Methods of Control 1. Treatments of Chlorotic Plants 2. Soil Studies 3. Biochemical Studies 4. Economic Aspects		F. B. Wann	Plant Pathology
	5. Development of Chlorosis-resistant Varieties of Small Fruits.....	1929	F. B. Wann and A. L. Wilson	Plant Pathology Horticulture
90	A Study of Factors Influencing the Financial Condition of Certain Utah Irrigation and Drainage Projects: 1. Engineering Aspects.... 2. Soil Productivity Aspects	1928	O. W. Israelsen	Irrigation
	3. Sociological Aspects	1929	D. S. Jennings	Soils
	4. Economic Aspects	1929	J. A. Geddes	Rural Sociology
		1929	W. P. Thomas	Agricultural Economics

³⁶In cooperation with Bureau Plant Industry, U. S. Department of Agriculture
³⁷Revised and approved on November 10, 1931 to include the five new parts listed, with A. L. Wilson cooperating.

No.	Title	Date of Beginning	Leader or Leaders	Department or Departments
Purnell Fund (Cont.)				
91	The Effect of Fertilizers on Various Properties of a Highly Calcareous Soil and on the Yield and Quality of Crops Produced	1928	D. W. Pittman D. S. Jennings J. E. Greaves	Agronomy Soils Chemistry
92	Psyllid Yellows of the Potato A. Disease Aspects..... B. Insect Aspects.....	1928	B. L. Richards G. F. Knowlton	Plant Pathology Entomology
98	Cooperative Marketing of Agricultural Products in Utah	1929	W. P. Thomas	Agricultural Economics
101	Economic Factors Affecting the Production and Marketing of Utah's Poultry Products.....	1929	W. P. Thomas	Agricultural Economics
102	Food Habits of Elementary Rural School Children in Relation to Their Physical Wellbeing	1929	Almeda Perry Brown	Home Economics
103	The Physical Curd Character of Milk and Its Relationship to the Digestibility and Food Value of Milk for Infants.....	1929	R. L. Hill	Human Nutrition
103-A	Physical Curd Character of Evaporated Milk.....	1930	R. L. Hill	Human Nutrition
105	The Nutritive Value of High vs. Low Calcium—and Phosphorus—Carrying Wheats	1929	J. E. Greaves	Chemistry and Bacteriology
106	Effect of Physical Curd Character of Milk on the Quality, Yield, and Physical Texture of Cheese.....	1929	R. L. Hill	Human Nutrition Chemistry and Bacteriology
107 ³⁸	The Mineral Content of Wheat	1929	J. E. Greaves	Chemistry and Bacteriology
108	Relative Market Value of Crossbred Lambs from Crosses of Purebred Hampshire, Suffolk, Rambouillet, and Corriedale Rams on Utah Range Ewes	1929	A. C. Esplin	Animal Husbandry
109	Comparative Values of Fleeces from Types B and C Rambouillet Ewes.....	1929	A. C. Esplin	Animal Husbandry
118	Study of Factors Promoting Positive Health in Rural School Children.....	July 1931	A. P. Brown	Home Economics

³⁸Cooperative with Department of Household Science, California University.

No.	Title	Date of Beginning	Leader or Leaders	Department or Departments
Purnell Fund(Cont.)				
122	Factors influencing Marketability of Onions.....	Sept. 1931	A. L. Wilson	Horticulture
126	Factors underlying the Formation of Double Onions and Scallions	Sept. 1931	A. L. Wilson	Horticulture
128	Bacterial Wilt of Alfalfa			Botany and Plant
	1. Pathological Aspects.....		B. L. Richards	Pathology
	2. Agronomic Aspects.....	Nov. 1931	R. J. Evans	Agronomy
	3. Joint Aspects.....			
141 ³⁹	Curly-top and Psyllid Yellows of the Tomato.....	July 1931	H. L. Blood F. B. Wann	Botany and Plant Pathology
State Fund				
1	Nephi Dry-farm Substation	1908	A. F. Bracken	Agronomy
2	Widtsoe Dry-farm Substation	1917	R. J. Evans	Agronomy
5	Moisture, Soil, and Crop Relations (Irrigation and Manuring Studies with Corn)	1911	D. W. Pittman	Agronomy
9	Rotation and Fertility Tests	1910	D. W. Pittman	Agronomy
10	Miscellaneous Crops	"Early"	R. J. Evans	Agronomy
34	Plant Disease Survey.....	1913	B. L. Richards	Botany and Plant Pathology
36	Breeding for Egg Production	1907	Byron Alder	Animal Husbandry
42	Grain Varieties	1918	D. C. Tingey	Agronomy
59	Davis County Farm.....	1920	A. L. Wilson	Horticulture
64	Cultural Methods with Sugar-beets	1921	D. W. Pittman	Agronomy
65	Weed Control	1921	D. C. Tingey	Agronomy
66	Panguitch Livestock Farm	1920	B. F. Hulme E. J. Maynard	Animal Husbandry
73 ⁴⁰	Production Costs in Dairy-ing (Dairy Substation).....	1924	G. Q. Bateman	Animal Husbandry (Dairy Husbandry)
74 ⁴¹	Egg-laying Contest.....	1924	Byron Alder	Animal Husbandry (Poultry)
75	Utah Basin Alfalfa-seed Farm	1925	J. W. Carlson	Agronomy
86	Peach-Harvesting Indexes....	1925	F. M. Coe	Horticulture
94	Cherry Pollination Studies	1928	F. M. Coe	Horticulture
95 ⁴²	Variety Testing	1928	F. M. Coe	Horticulture

³⁹Assigned a definite project number on June 1932.

⁴⁰Revised, January 16, 1932.

⁴¹Closed temporarily, November 1, 1931.

⁴²Also carried on Hatch Fund.

No.	Title	Date of Beginning	Leader or Leaders	Department or Departments
State Fund (Cont.)				
96	Sanpete County Farm	1927	LeMoyne Wilson	Agronomy
97 ⁴³	Carbon County Farm.....	1927	I. D. Zobell	Agronomy
99 ⁴⁴	Fattening Lambs in Winter Dry-Lot			
	A. Lamb-feeding Experiments, Monroe		E. J. Maynard	
	B. Lamb-feeding Experiments, Delta	1928	A. C. Esplin	Animal Husbandry
100	San Juan County Farm.....	1925	J. H. Eagar	Agronomy
104	High-Altitude Metabolism Studies on Women.....	1929	C. B. Clayton R. L. Hill	Home Economics Human Nutrition
111	Swine Feeding Experiments			
	A. Summer Fattening Experiments (Alfalfa Pasture)			
	B. Winter Fattening Experiment (Dry-lot)	1930	H. H. Smith	Animal Husbandry
112	Alfalfa-seed Investigations in Millard County.....	1929	George Whornham	Agronomy
113	Types of Greens or Pot Plants Used in Utah Homes	1930	A. P. Brown	Home Economics
114	Studies of Cattle Affected with Bang's Disease.....	1930	D. E. Madsen	Animal Husbandry
115	Bunt Control			Agronomy
	A. Agronomic Phase		D. C. Tingey	Plant
	B. Pathological Phase	1930	B. L. Richards	Pathology
116	Family Living Expenditures in Utah	1930	W. P. Thomas Edith Hayball	Agricultural Economics
117	Transmissibility of Bang's Disease among Dairy Cattle in a Utah Dairy Village	1931	D. E. Madsen	Animal Husbandry
119	Boxelder County Farm.....	1931	F. M. Coe L. M. Winsor ⁴⁵	Horticulture Irrigation and Drainage
120	Washington County Farm..	1931	A. L. Wilson H. L. Blood F. M. Coe	Horticulture Botany and Plant Pathology
121	Studies on Fowlpox.....	1931	D. E. Madsen	Animal Disease Laboratory

⁴³Parts A and B added July 30, 1931(in cooperation with Irrigation Department)

A—Drainage and Reclamation of Alkali Spots.

B—Irrigation and Erosion Studies of Carbon County Soils.

⁴⁴Project 99-B(Delta) discontinued June 30, 1931

⁴⁵Irrigation Engineer, Division of Agricultural Engineering, U. S. Department Agriculture.

No.	Title	Date of Beginning	Leader or Leaders	Department or Departments
State Fund (Cont.)				
123	Improvement of Sweet Spanish Onions	1931	A. L. Wilson	Horticulture
124	Use of Plant Protectors and Paper Mulch in Vegetable Production	1931	A. L. Wilson	Horticulture
125 ⁴⁶	The Susceptibility of Cattle to Inoculations with Acid-fast Organisms Isolated from so-called Tubercular Skin Lesions		D. E. Madsen	Animal Disease Laboratory
127	Miscellaneous Onion Studies	Oct. 1931	A. L. Wilson	Horticulture
129	Variety Tests of Small Fruits	Sept. 1931	A. L. Wilson	Horticulture
130 ⁴⁷	Methods of Planting and Plant-growing Structures..	Oct. 1931	A. L. Wilson	Horticulture
131	Effect of Dried Molasses Beet Pulp Added to a Standard Grain Mixture in Milk Production	Dec. 1931	G. B. Caine G. Q. Bateman	Animal Husbandry (Dairy Husbandry)
132	Corn and Cottonseed Cake as Concentrated Supplements for Wintering Sheep on Desert Ranges of Utah	Dec. 1931	E. J. Maynard A. C. Esplin R. J. Becraft J. E. Greaves	Animal Husbandry Range Management Chemistry
133	Cattle-feeding Experiments	Jan. 1932	E. J. Maynard J. E. Greaves	Animal Husbandry Chemistry
134 ⁴⁸	A Study of Organization and Management of Utah Farms	May 1932	W. P. Thomas	Agricultural Economics
135 ⁴⁹	The Intermountain Herbarium	1931	B. Maguire B. L. Richards	Botany
137 ⁵⁰	Miscellaneous Fertilizer Trials	1926	D. W. Pittman	Agronomy
140 ⁵¹	Animal Disease Laboratory	1929	D. E. Madsen	Animal Husbandry

⁴⁶Cooperative with State Department of Bacteriology and Bureau of Animal Industry, U.S.D.A.

⁴⁷Cooperative with Utah Power and Light Company.

⁴⁸Cooperative with Howells Company, Inc. of Salt Lake City.

^{49,50,51}Approved as regular Station projects on June 14, 1932.

SUMMARY OF RESULTS OF INVESTIGATIONS

Agricultural Economics

In the study of factors influencing the financial condition of certain irrigation and drainage projects, the records taken in West Millard County on the farm business for 1929 and 1930 have been analyzed and preliminary reports issued on the results. Approximately 100 farm business records have been secured each year from farmers living in the area. Data have been analyzed according to types of farming and soil types, giving capital invested, indebtedness, acres in farm, crop and livestock production, and farm income and expense. These data will be used as basic information in studying the reorganization of the farm business in that section. (Project 90-D)

In cooperation with the Bureau of Agricultural Economics, U. S. Department of Agriculture, an investigation has been conducted on economic factors affecting the production and marketing of Utah's poultry products. Detailed poultry records on approximately 100 farms have been taken each year. An analysis of these records has been made, in which is given a summary of the farm business and poultry enterprises, cost of producing eggs, and cost of rearing pullets. In addition to studying poultry production, data on price trends and competition with other poultry-producing sections have been collected and will be used in the final report in the analysis of this industry. Miscellaneous Publications Nos. 8 and 9 give results of the poultry survey for the years 1928-29 and 1929-30. (Project 101)

An analysis of income and living expenditures of farm families in Summit County has been conducted cooperatively with the Extension Service. The object of the project is to study the distribution and efficiency of the expenditure of the cash available for family living on the basis of varying incomes and the relationship between the net farm income and family expenditures. Utah Station Bulletin 232 contains a report of the findings of the survey made in Summit County (Project 116)

In cooperation with the Extension Service, a study on farm organization and management of Utah farms has been initiated. Approximately 350 farmers kept complete records of their farm business during 1931; of these farm accounts 150 have been checked and analyzed by county. In 1932, 460 farmers have been cooperating in this study. (Project 134)

Index numbers and purchasing power for various farm commodities in Utah have been determined monthly from prices paid producers. This monthly report on price index has given a picture of the price relationship between Utah's farm products and non-agricultural commodities. Information giving index of industrial production, employment, factory payrolls, wholesale prices for United States and foreign countries has been issued monthly as Station Mimeograph Sheets, with the report on prices of Utah farm commodities. (No number assigned)

Agronomy

The Nephi Dry-land Substation was started in 1903 by a special State appropriation. In 1907 the Government began cooperating with the state in conducting experimental work. The work started in 1903 was enlarged in 1907 and new projects have continued to be added as demands have broadened and needs for information have increased. The purpose of this project has been to determine best tillage practices,

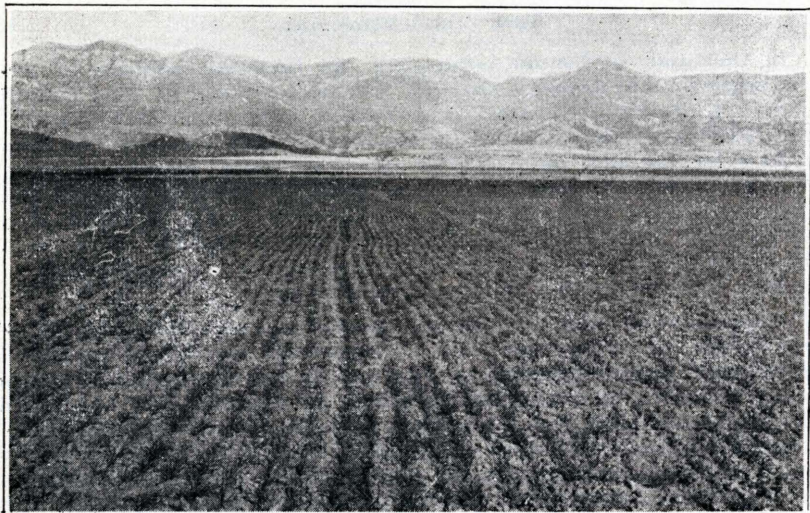


Fig. 1.—Wheat seeded early enough in the fall to tiller before winter almost insures normal or better than normal yields the following season.

cropping arrangements, rotation, fertility relationships, cereal varieties, and rates and dates of seeding as well as a few miscellaneous tests best adapted to the successful operation of the dry-lands. In addition, some of the work deals with the more fundamental problems of dry-land agriculture such as the relation between nitrate accumulation and soil moisture and the effect this has on quality of wheat and yield.

The yields for crop seasons of 1930 and 1931 were approximately normal. The crop of 1930, with average crop yield of 20.8 bushels, was 90 per cent normal and that of 1931, with an average plat yield of 24.53, was 106 per cent normal. The precipitation for 1931 amounted to but 7.42 inches, which was 57 per cent normal, and the lowest on record. The higher-than-normal production for 1931 was due to early fall emergence of the wheat in a productive fallow.

Plowing and cultural tests for 1931 showed a decided advantage for normal care of fallow rather than hoeing and pulling; the averages and the yields for 1930, however, indicated little variation, especially for spring plowing. Neither frequent harrowing of the fallow nor fall disking preceding fall or spring plowing had any advantage over the normal treatments. The results on depth of fall plowing demonstrated that plowing or breaking the soil deeper than 7 inches is not necessary and that one plowing, given either in fall or spring, is all that is needed.

Variations in yields are so slight (with the exception of the 1930 results) on land tilled with the disk harrow that no significance can be attached to the differences. However, the importance of this is far-reaching: Plowing with either a large disk plow or disking with a tandem disk harrow cuts the cost in half.

In fertility tests conducted, the **application of manure** every four years in various amounts has given increased yields for the heavier amounts. The 1930 and 1931 results, however, show that even the smaller amounts have increased yields when compared to the check. In **green-manuring** check-plats and wheat following peas plowed under 6

inches high average yields were approximately the same; later stages were followed by reductions in yield of grain. The percentage of protein was noticeably increased by plowing under peas when 12 inches high and at both the bloom and pod stage. Results from plowing under wheat as a green manure crop for the 12-inch bloom and dough stages give proof of a marked and progressive reduction in yield. No variation in the percentage of protein is indicated.

Burning all or part of the stubble gave slightly higher yields than plowing it under, with one exception. The 16-year averages indicate the same difference, which has been uniformly consistent throughout the test.

Results of the **cropping experiment** indicate alternate crop and fallow with fall or early spring plowing to be the safest method of cropping the dry-land when the precipitation is near the amount and similar to the distribution of that at Nephi. The test also gives evidence that tillage is reflected in the yield even though meager.

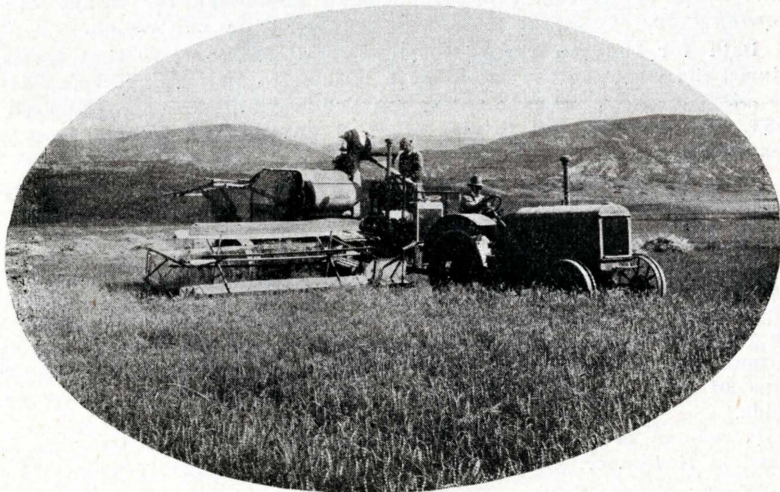


Fig. 2.—Ready for the annual harvest of dry-farm wheat.

In the **rotation experiment**, wheat has been given a major position in the crop sequence associated with such other cereals as oats and barley and row crops consisting of peas, potatoes, and corn. Striking differences are observed between the 1930 and the 1931 yields, due to late seeding of wheat necessitated by the late harvesting of potatoes and to the severe drought beginning in the fall of 1930 and continuing throughout 1931. In comparing wheat acre-yields following fallow and the intertilled crops, the average difference amounted to about 2 bushels or less. The yields of the intertilled crops following wheat with the same crops following fallow showed marked reductions for corn and potatoes after fallow. Apparently a soil-organic-matter relationship is responsible for overbalancing the effect of the extra moisture associated with the fallow.

In **varietal trials** of winter and spring wheat of nineteen winter wheats, the average yields for over the past 5-year period place Turkey 26 first, followed by Turkey 926. A 9-year average places Baart, a

spring wheat variety, first in yield, followed by Chul. Neither 1930 nor 1931 was favorable for spring cereals.

In a **date-and-rate-of-seeding test** the 1931 yields indicated that in seasons of high, late summer rainfall early seeding is of distinct advantage. For 1930 after August 1, little variation in yield occurred up to and including October 15. In dry fall seasons late seeding is an advantage, as is indicated by a 10-year average. Yields for 1930 for different rates of seeding showed a progressive increase in yield from 2 to 3 pecks, inclusive. The 6-peck seeding, however, seems to have been the point of highest net return. The 1931 yield indicated the same point for highest net return, but the increase in rate was not associated with the same progressive regularity in yield as was indicated in the 1930 yields.

The 1930 and 1931 results contradict each other on **cultivation of the growing wheat**. The 1930 yield significantly favored no cultivation, while the 1931 average indicated a small advantage for tillage of the growing crop. The 5-year average is in favor of no cultivation.

Data for 1930 in regard to **smut treatment** indicate that formalin injured the wheat to the extent of 5 bushels to an acre as compared to the use of copper carbonate. No marked variations were observed in 1931. The averages fail to give proof of any marked damage from wet treatments.

From a series of tests with the **furrow drill versus the ordinary drill**, it is evident that the furrow drill has but slight advantage over the ordinary drill.

In a study of **soil nitrates and moisture, together with yield and protein content of the wheat**, in the fall of 1930 the nitrate content of the normally treated plat was near or a little in excess of the average; the yield from these plats in the crop season of 1931 was 106 per cent normal. The favorable soil moisture conditions following late summer rains of 1930 tended to mask the effect of late plowing in the 1931 yields.

A resume of twenty-five years of dry-farm experiments was published in November, 1930 (Utah Station Bulletin 222). (**Project 1**)

Work on the **Widtsoc Farm** has been greatly impaired because of extreme drought and crops have been almost total failures for several years. This farm has filled the purpose for which it was established in 1917 and arrangements are being made to cease operations at the close of the present crop year. (**Project 2**)

A study of the effect of different amounts of irrigation water and **barnyard manure on corn and on the soil**, begun in 1911, has been continued under the same general treatment. Maximum yields of ear corn have been produced with 20 to 30 inches of irrigation and the maximum yield of stover with 30 inches. Manure has consistently and markedly increased yield; lighter applications of manure have been more effective per ton of manure, but larger yields have been obtained with heavier applications. The content of nitric nitrogen and soluble phosphorus of the surface soil is highest with the heavier manuring and no irrigation and lowest with no manuring and the heaviest irrigation, with intermediate treatments giving intermediate results. The nitrate content of the surface soil is higher in the fallow plats than in the corn plats; this, however, is not the case of soluble phosphate content. In 1931-32 the manuring and differential irrigation has been discontinued and the plats have been seeded down to alfalfa which

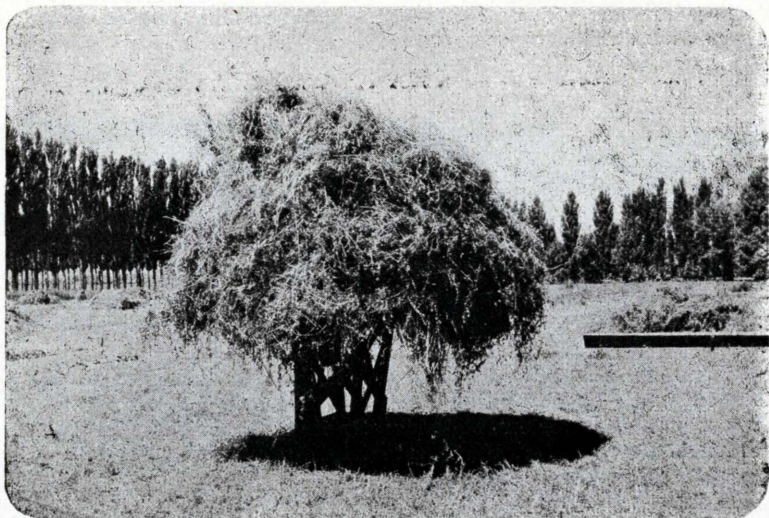


Fig. 3.—Weighing the crop, Central Experimental Farm (Greenville).

will be irrigated uniformly to study the residual effect of these previous treatments. (Project 5)

Rotation and manuring tests on the Greenville Farm, begun in a small way several years ago, now include 87 of the older and originally less productive plats to determine the effectiveness of different cropping and manuring systems in increasing the productivity of the soil. Manure is shown to be essential in the production of sugar-beets, highly beneficial to alfalfa, potatoes, corn, and peas; in moderate quantities it is beneficial to small grains. Manure has greatly increased the content of soluble phosphorus and nitrate nitrogen in the surface of this highly calcareous soil. Under these particular conditions, green manure has not been especially effective in increasing either crop yield or available plant-food in the soil. Rotation has been particularly valuable in increasing the yield of small grains and has been more or less beneficial to all crops. Practically all crops do better following sugar-beets or potatoes than they do following the other crops, and these crops leave more soluble phosphorus and nitrate nitrogen in the surface soil than any of the other crops. None of the legumes appear to increase the available nitrogen in the soil when no manure is returned to the soil. Utah Station Bulletin 228 (June, 1931) includes results on this project. (Project 9)

Under **miscellaneous crop studies**, pasture studies have been somewhat modified. A special pasture committee has been appointed to outline a general pasture program and to unify various pasture investigations. Two experimental fields will probably be planted in 1933: One at the Panguitch Livestock Farm and the other near Logan. This work will include mixtures and either fertilizers or grazing experiments. The pasture study started on the Dairy Experimental Farm is to be reorganized in 1932-33, preliminary plans of which have already been outlined. A forage-crops nursery, including 64 varieties and selections of

grasses and 25 of legumes, has been started on the campus to supply material for student laboratory work and for research.

The sugar-beet breeding project, established in 1929 on a cooperative basis with the U. S. Department of Agriculture, has been continued. The chief phases of this project during the past two years have consisted of (1) a statistical study of beets inoculated with the curly-top virus, (2) distance isolation of beets in a continuation of inbreeding studies, and (3) selection and breeding for resistance to curly-top. Minor phases of the project consisted of a study of color inheritance in sugar-beet x red beet cross; in 1931, a preliminary test of single-germ beet seed was begun. (Project 10)

Since no funds were available for grain variety testing in 1931-32 investigations have been included in the work done under Purnell Project 62. However, this project should be continued and the variety testing at substations and other representative areas more fully developed. (Project 42)

Studies on the genetics of spike density, awning resistance to bunt and blackstem rust and other characters in wheat substantiate the fact that winter wheat yields are generally higher than for spring wheats. Abundant water-supply was of material help in crop yields.

While Turkey and Kanred are the leading winter wheat varieties grown in this section, they are both susceptible to bunt; accordingly, an effort was made to breed bunt-resistant strains. Some of these strains have given satisfactory yields in comparison with Turkey and Kanred. Trebi was the highest-yielding variety of barley grown in the State Uniform Nursery.

Markton oats appear to yield somewhat better than other oat varieties, although Swedish Select is the leading commercial oat in this state. Early to medium-early corn varieties are generally better adapted to northern Utah according to the 1931 test. From the preliminary test of grain sorghum, it appears that strains of Milo are the most promising for the different sections of the state.

During the past biennium the following publications on this project have appeared: Reprints Nos. 170, 175, 176, 188, 192, and 201. An article on "Inheritance of Dwarfing in Wheat" will appear in an early issue of the JOURNAL OF AGRICULTURAL RESEARCH. (Project 62)

In the genetic and breeding work conducted at the Nephi Substation, but 31 purelines remain from 500 original strains from which gradual elimination has been made. The purpose of this study has been to isolate a high-yielding strain having good milling quality as well as strong straw. Two selections, No. 26 and No. 926, have resulted. Turkey 26 is rather widely grown in certain parts of Utah. Turkey 926 has a little stronger straw than No. 26 and at Nephi a higher yield. Several strains coming out of the crosses between Sevier and Kanred and Sevier and Odessa are especially promising. The yield data show high yields; several have strong straw. There has always been a demand for a high-yielding, good quality, strong-strawed, dry-land winter wheat by both the milling trade and poultrymen. Kofod and Goldcoin, both having white kernels, have been grown in answer to this demand, but neither one has high-yielding power as determined by varietal trials.

Ten years ago, when the header and stationary thresher were in common use, there was a demand for a beardless hard red dry-land wheat variety. In response to this demand several crosses between Kanred and Kofod and Kanred and Alton were made. One strain resulting

from these crosses has been included in the varietal trials for several years; in the averages it has ranked with the leading varieties. In the 1931 yields it came first by a significant margin. (Project 62-F)

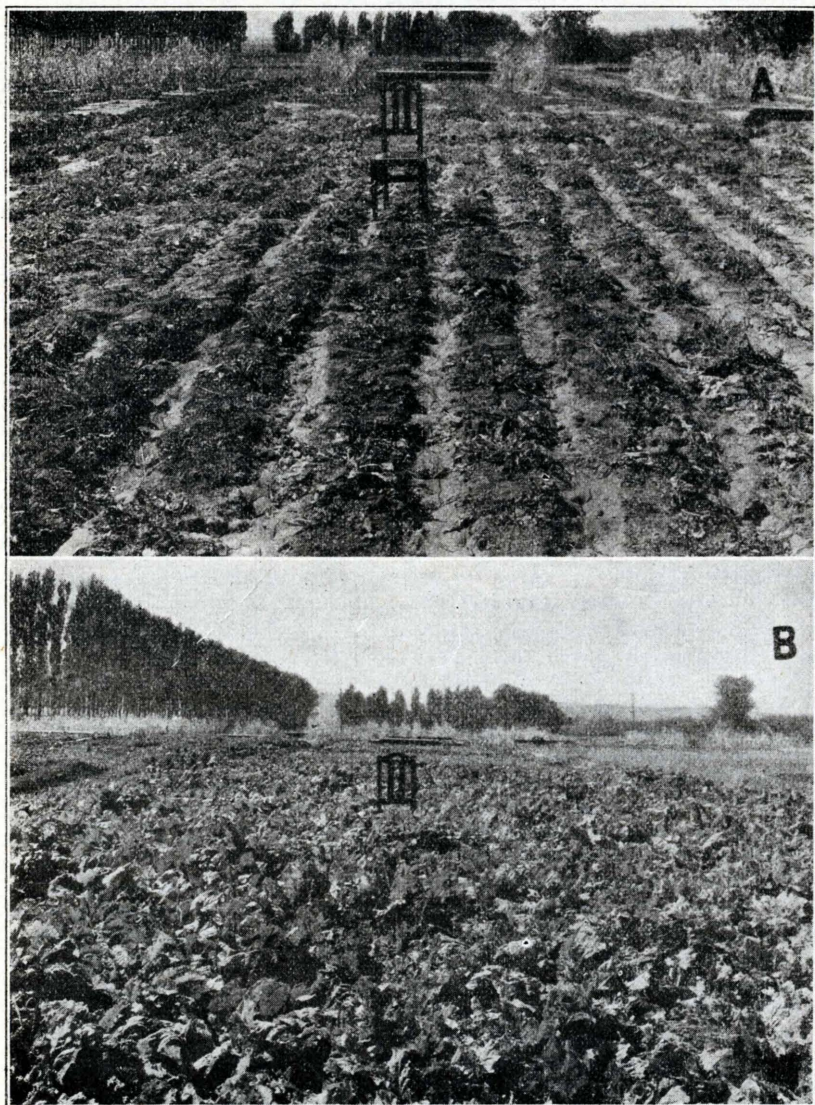


Fig. 4.—Manure is especially needed in "blight years." Plat A has never been manured and the beets were practically all destroyed by "late blight" or "root rot." Plat B touches the near corner of Plat A but has been manured for several years. (Photographed on the same day with the same chair for comparison.)

As a part of the experiment of **cultural methods with sugar-beets**, attempts at mechanical blocking in the past have not been successful because of the poor quality of the stand. A more careful attempt is being made to stimulate mechanical blocking by hand, although the stand hardly seems adequate for this. Early planting, manuring, and a good seedbed apparently are the important factors in securing a good stand. Station Circular 93 (April, 1931) represents certain phases of work done under this project. (Project 64)

During the past two years extensive experiments have been conducted on the **control of weeds** to determine (1) the possibility of using chlorates in weed control and (2) the relative costs and effectiveness of different tillage methods in comparison with chlorates. These experiments have been conducted in Salt Lake, Davis, and Cache Counties. The principal chemicals used were calcium and sodium chlorate and miscellaneous commercial weed killers. Tests were made on whitetop (*L. draba*), morning glory (*C. arvensis*), Canada thistle (*C. arvense*), and perennial sow thistle (*S. arvensis*).

Variations in tolerance to different conditions make the use of chlorates very uncertain. No assurance of successful eradication by this means is possible unless an unreasonably large amount of chemical is used. It is advisable, in weed eradication, to first try out chlorates on small areas before applying it on any appreciable area of land.

Of all chemicals advocated for weed control, doubtless chlorates are superior, when considering ease of handling and general effectiveness. Therefore, on small areas and in inaccessible places the chlorates are highly valuable in weed control. However, chemicals should be used with discretion. Chlorates are not a substitute for good farming and thorough cultivation. They are merely an aid to successful weed control. Experiments comparing thorough tillage with chlorates gave most satisfactory results in favor of tillage, both from the standpoint of costs and effectiveness. (Project 65)

During the past biennium, some of the investigations on the **Uintah Basin Alfalfa-seed Farm** have been completed. Yield data have been obtained on alfalfa-seed produced under most of the practices used in the Uintah Basin, when the crop is incidental to the major enterprise of growing alfalfa hay for feeding livestock. Results of experimental work are reported in detail in Utah Station Bulletin 226 (May, 1931), Circular 97 (March, 1932), and Reprint 197 (February, 1932). A new alfalfa varietal forage and seed-production test, including practically all of the standard hardy northern varieties as well as the mid-hardy common alfalfas and several of the non-hardy southern strains, have been initiated. Several selected strains, known to be superior either as seed producers or to be especially disease-resistant, are also included in this test. This test is not only being conducted on the large plats at the farm in the Uintah Basin in the forage test by single-row plats replicated four times but it also being tried out at six other substations. (Project 75)

Fertilizer tests showing their effect on yield and the composition of crops and on soil properties on a highly calcareous soil near Logan show a pronounced response to phosphorus for both sugar-beets and alfalfa, although it is much more pronounced in sugar-beets. Wheat and barley have shown some response to both nitrogen and phosphorus and apparently some response to potash. To date potatoes do not seem to have been affected to any marked degree. Heavy applications of raw

rock phosphate to this particular soil in connection with manure and sulphur do not seem to have any more effect than manure alone. Some

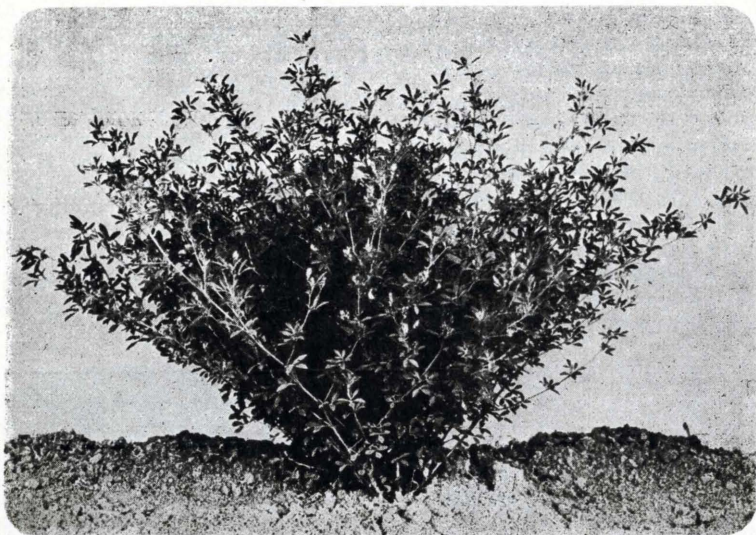


FIG. 5.—This sturdy plant grew from an alfalfa seed inherently vigorous. The importance of having more such plants in alfalfa-hay fields is apparent.



FIG. 6.—A test strip fertilized with phosphorus in a sugar-beet field that needed it.

of the results of this experiment are reported in Utah Station Bulletin 233 (January, 1932). (Project 91)⁵²

Field-crop studies on the Sanpete County Farm include varietal tests of barley, oats, wheat, corn, sorghum, flax, and potatoes. In 1930, 25 varieties and strains of barley were grown in a rod-row nursery; in 1931 this number was increased to 66. In both years barley was highest yielder. Of 109 varieties and strains of oats grown in the nursery in 1931, Markton was the highest yielder. Of 10 varieties of corn grown in 1931, Extra Early Rustler gave the best yield. Only the very early maturing corn varieties matured. The potato-variety test, including six varieties of early potatoes, showed the Irish Cobbler to be the most promising variety in 1931 and in 1932. No definite data are available for wheat, sorghum, and flax. Grain varietal studies were conducted in cooperation with the Cereal Office, Bureau Plant Industry, U. S. Department of Agriculture.

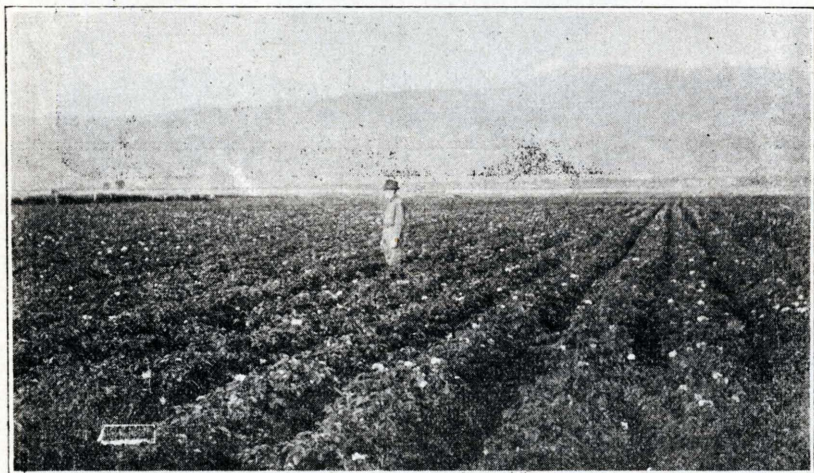


Fig. 7.—A 5-acre field of Cobbler potatoes grown on peat land adjoining Sanpete County Farm.

In an attempt to find vegetable crops best adapted to this region, a large number of different crops have been grown. The more promising ones include: Asparagus, carrots, cabbage, cauliflower, celery, table beets, parsnips, peas, and onions planted from sets and seedlings. Irrigation tests with cabbage, cauliflower, and celery showed the necessity of irrigation for these crops not only at the time of planting but during the growing season as well.

Rolling the soil with a heavy cement roller, after seeding barley, oats, and peas, resulted in a marked increase in yield of these crops, as compared to adjacent unrolled plats. Injury to crops due to spring frosts was much reduced on the rolled plats.

A significant increase in barley yields was obtained on muck soil receiving applications of either barnyard manure or of treble-superphosphate. Maintaining the soil in a summer-fallowed condition for two years was approximately as effective in increasing the productivity of

⁵²Chemical analysis report included under Irrigation, Physics and Soils.

the soil as was either the addition of manure or the phosphorus fertilizers.

Determinations of the alkali content of the soil from different parts of the muck soil drainage area showed that chloride and sulphate salts are present in abundance over the entire area. Studies at the experimental farm, where soil samples were collected three times each year, indicate that salt is more concentrated in the top foot than in the second foot of soil. Fluctuations in the amount of alkali during different seasons of the year were apparent. Station Bulletin 224 (April, 1931) reports the progress made on this farm since its establishment in 1927. (Project 96)

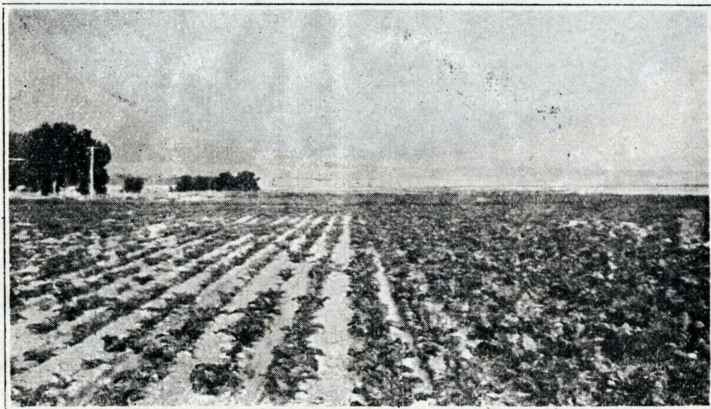


Fig. 8.—Sugar-beet plats, Carbon County Farm, on which treble superphosphate has been applied (right) and check plat (left).

Weather conditions on the **Carbon County Farm** during the past biennium have been especially unfavorable to successful crop yields. The soil was in poor condition for a seedbed in the spring, making it necessary to cultivate the land to break up the large clods. Because of the few winter storms the water-supply was 30 per cent of normal. Investigations at present are being conducted on the following crops: Alfalfa, corn, potatoes, wheat, oats, barley, beans, sugar-beets. A test in commercial fertilizers is also being conducted, which indicates that barnyard manure supplemented with phosphorus increases noticeably the acre-yield; the use of manure and phosphorus also gives the young seedlings a stimulation which helps them to withstand drought as well as attacks of disease and of insects. Alfalfa plats, fertilized with phosphorus in 1929, continued to give an increase in yield. In addition to the regular crop tests, five varieties of flax were grown in a nursery test in cooperation with the U. S. Department of Agriculture. A permanent woodlot and windbreak has been started with western yellow pine, Douglas fir, Colorado blue spruce, Australian pine, Siberian elm, black locust, white ash, Russian olive, Balm of Gilead, honey locust, black walnut, and golden willow. Three of these—Siberian elm, Balm of Gilead, and Russian olive—have not proved to be sufficiently winter-hardy for this section. Results of investigations from the time of the establishment of the farm in 1927 are reported in Utah Station Bulletin 225 (April, 1931). (Project 97)

Because of continued frost damage from year to year, the original



Fig. 9.—Beans have proved a most profitable crop in San Juan County.

site of the **San Juan County Farm** was changed in the spring of 1932. The new location is more representative of the farming area of this county. In spite of the lack of soil preparation when needed, before the new farm site was selected, prospects are most auspicious for good crops this season. Utah Station Bulletin 230 (June 1931) reports in detail results of investigations from the time of the establishment of the first farm in 1925. (Project 100)

Investigations of alfalfa-seed problems in Millard County, begun on July 1, 1929, have consisted of (1) irrigation studies, (2) cultivation studies, (3) clipping experiments, (4) spacing experiments, (5) methods of production on successful farms, (6) fertilizer investigations, (7) studies of seed production on different soil types, and (8) miscellaneous crop tests.

Realizing the need of other crops, in addition to alfalfa hay and seed, uniform varietal tests of wheat, oats, barley, corn, and sorghum are being grown in cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture. Several other crops are being grown with fair success. Grasses and clovers have also been planted. A series of alfalfa varieties was planted to determine forage and seed possibilities. Population counts of the various insects doing damage to alfalfa seed have been made by the Station Department of Entomology at regular 10-day intervals during the growing season. This work is being continued during the present season. (Project 112)

During the fall of 1930 seed of two varieties of wheat (Kanred and Silvercoin) was treated for bunt control in 21 different ways. This treated seed was sown in Cache, Boxelder, and Juab Counties. High percentages of smut were clearly evident on the fall-seeded grain in four of the five areas where plantings were made in Cache Valley, even though the seed had been carefully treated previous to planting. This further substantiates results secured in 1929-30 and also shows that soil infection is doubtless a major factor in increasing the prevalence of smut, in Cache Valley at least. No smut occurred on the plantings made in Boxelder County, regardless of the fact that some of the grain had been heavily inoculated with smut previous

to planting. While it is fairly certain that soil infection is a major factor in increasing the prevalence of smut, it is not known why some fields are so heavily infected with smut year after year while other fields are not. Chemicals used in bunt control were copper carbonate with 18 and 50 per cent copper, copper sulphate (blue vitriol), and formalin. It was apparent from the tests that no one treatment was appreciably more effective than any other. (Project 115-a)

A survey of Salt Lake and Utah Counties was made during the summer of 1931 to determine the extent of **bacterial wilt of alfalfa** from an agronomic viewpoint. One hundred individual plant selections were made in August, 1931, on which genetic observations were made as to number, length, and thickness of stems; number, size, and color of leaves; color of flowers; and general habit of growth. Seeds were harvested and kept for the 1932 planting. Additional varieties and strains of alfalfa seed were supplied by the Bureau of Plant Industry, U. S. Department of Agriculture, including a wide range of possibilities. Experimental work is now proceeding on the 6.5-acre experimental tract near Union in Salt Lake County. Different irrigation treatments are given, since it is felt that irrigation is undoubtedly an important factor in wilt development. Studies are also being made on 26 selections of alfalfa on the Uintah Basin Alfalfa-seed Experimental Farm. (Project 128-B)

The results of the joint aspects in regard to investigations in **bacterial wilt of alfalfa** are included under the Department of Botany and Plant Pathology. (Project 128-C)

A series of over 250 preliminary **miscellaneous fertilizer tests** in different parts of Utah has been conducted in cooperation with county agricultural agents and farmer cooperators. This work has been financed in part by a fellowship furnished by the Barrett Company of New York. It has been found that alfalfa and sugar-beets often give a notable response to phosphorus fertilizer and to bluegrass, lawns and pastures, to strawberries and small fruits and that the small grains often give a good response to nitrogen. In many cases there was no response whatever to the fertilizer, and it was impossible to locate any geographic regions of universal response or lack of response. Results of this work to date are published in Station Bulletin No. 233 (January, 1932). (Project 137)

Animal Husbandry

Special consideration has been given in the selection of **breeding for egg production**. This project was discontinued in November, 1931, and the data are now being prepared for publication. The unusually dry hot summer and the outbreak of bronchitis and fowl paralysis have no doubt had a depressing effect upon egg production during the past year. In spite of these handicaps, however, some interesting records have been made: One hen finished her ninth year with a record of 1223 eggs, while another produced 1142 eggs in seven years; a six-year record of 1023 eggs was attained by one hen, while another produced 831 eggs in four years. (Project 36)

Poultry feeding studies have been enlarged during the past year and now include the following divisions: (1) Methods of feeding grain to the laying flock, (2) soft white wheat vs. hard red wheat as a feed for Leghorn hens and pullets, and (3) all-night light vs. morning light for Leghorn hens and pullets. Bronchitis and fowl paralysis,

which appeared early in the year in each pen, caused heavy mortality. (Project 57)

Registered Shorthorn cattle have been sold from the **Panguitch Livestock Farm** in five different counties of southern Utah. Improvement of range cattle throughout southern Utah is largely a result of the use of breeding animals produced on this farm. The herd is in healthy breeding condition. An experiment in wintering beef cows was conducted during the winter of 1931-32. A more systematic plan of crop rotation has been established on the farm. An 8-year rotation is planned, in which the farm is divided into fields of about equal size to rotate alfalfa, grain, and cultivated crops. The grain nursery begun in 1929-30 has been continued; an alfalfa nursery has also been established at the request of local farmers, in which 24 varieties of alfalfa are being tested in an effort to discover the most suitable variety for local and similar conditions. Herd, soil-improvement, and crop studies will be continued. A bulletin covering investigations on this farm for the past several years is in course of preparation. (Project 66)

Practically all of the feed used for the dairy herd, for conducting **production studies in dairying** was raised on the Dairy Farm where these investigations are being conducted. The dairy experimental herd at the present time is made up of 25 Holstein cows, 18 bred heifers, 7 heifer calves, and two proved herd sires furnished by the Bureau of Dairying, U. S. Department of Agriculture. On April 10, 1930 when the positive and negative animals to the abortion test were segregated there were only 11 head of cows and 21 heifers left which were negative to the test. The herd has been built up to its present size of 50 females without the purchase of any additional female stock.

In the early spring of 1932, this project was revised to include (1) a standard method of management of all daughters of proved sires and (2) a study of individual lactation periods with Holstein cows to determine what production can be expected on three different home-grown rations. An effort is being made to breed a herd of dairy cattle which will tend to be pure for those factors which determine a high level of milk and butterfat production. Utah Station Bulletin 229 (June, 1931) on "Production Study of 160 Dairy Herds" represents work done on this project.

A manuscript has been prepared, for early publication, entitled "Wet Beet Pulp and Corn Silage in the Dairy Ration." (Project 73)

Of the 36 entries in the **egg-laying contest**, 29 were Single Comb White Leghorns, three were Rhode Island Reds, and four were Plymouth Rocks. Seventeen of the 36 entries were from Utah. Infectious laryngotracheitis and fowlpox appeared soon after the birds were placed in the Contest Building. These diseases were more or less active during the winter and spring months. In some entries practically all birds died; the death loss in the contest flock was extremely heavy. Since the birds were all housed in one building there was little chance to isolate affected birds; thus the diseases spread through the entire flock. Because of this and also because the Contest Building is located on part of the poultry experimental yards, it has been decided to discontinue the egg-laying contest until more suitable quarters can be provided. An annual summary was issued on November 1, 1931, which included data on feed consumption, weight of birds, and number and weight of eggs produced by the birds in each entry. (Project 74)

Studies on the **effect of winter feed and shelter vs. open-range**

wintering on the quantity and quality of wool from Utah range ewes indicate that fleece condition of the Station-bred group has been superior to that of the Range-bred group. Results of a five-year study on this project, however, are now being prepared for publication and should be available in the near future. (Project 77)

No injurious effects on livestock from feeding sugar-beets and their by-products have been observed during this biennium. Some difficulties, however, were encountered where animals had been allowed large quantities of this feed before becoming accustomed to it and where cows had been turned into fields of beet tops. Good sugar-beet pulp contains from 1 to 1.5 per cent of lactic and acetic acid; where such material is fed for a long period of time to the same animals supplemental feed must be given to neutralize this acid found in the pulp. In most cases pulp is only fed a short time and is usually supplemented with plenty of alfalfa hay, but it is also possible that pulp can be treated with calcium phosphate or other calcium salts to neutralize the acidity. When sugar-beet molasses was given to lambs, they were not affected with sore mouth when brought into the feedlot; the same was true of calves after weaning and put on feed. Cattle often develop a depraved appetite where they have been fed for long periods on beet by-products. If affected animals are given sufficient calcium phosphate this condition can be overcome. (Project 78)

The recent plowing up of the pastures has temporarily interfered with the progress of the experiment on pasture studies with beef cattle conducted on the Panguitch Farm. However, results of this investigation from the time of its initiation in 1927 are being compiled for early publication. (Project 84)

In miscellaneous investigations in veterinary science a number of animals in Station and College herds showed a suspicious reaction to the interdermal tuberculin tests. All of the animals in these herds have been tested for tuberculosis, but no definite reactors have been found. Experimental treatments for milk fever have been made by injecting calcium glucinate or calcium chloride into the blood stream; in one case the air treatment was also given. An outbreak of keratitis was also investigated and treated. The eyes of the affected animals were washed with a mild disinfectant and inoculated with keratitis bacterin; in about ten days no further trouble was observed. An outbreak of vaginitis is at present under observation and treatment. This affection occurs most generally among heifers. Miscellaneous investigations have also been carried on with sheep, hogs, poultry, and horses. (Project 87)

The test for fattening lambs in the winter dry-lot has been continued at Monroe. The test at Delta has been discontinued. Results indicate that the experiment has been of demonstrational as well as of research value. A publication on results obtained both at Monroe and at Delta is in course of preparation. (Project 99)

The ewes of Project 77 were bred to Hampshire and Suffolk rams in 1929 to determine the relative market value of crossbred lambs from crosses of purebred lambs on Utah range ewes. The lambs of 1930 were compared for birth weights, percentage crop, daily gains, selling weight, and grade. Suffolk-cross lambs at birth were 1 pound heavier than Hampshire crosses. There were more twins in the Suffolk group and 149 per cent Suffolk cross lambs docked as compared to 129 per cent Hampshire cross. The average weight of 27

Hampshire lambs which were sold was 6.9 pounds heavier per lamb, while the weight of the 31 Suffolk-cross lambs sold was 290 pounds more than that of the 27 Hampshire lambs. The selling price was the same for both groups. The grade of live lamb was slightly in favor of the Suffolk group, while the carcass grades were slightly in favor of the Hampshire group. (Project 108)

Studies on the comparative values of fleeces from Types B and C Rambouillet ewes have been made on the Station herd on the Panguitch Farm. It was found that grease weights of fleeces of B type were greater by 1 pound in all ages than in the C type and 0.23 pound greater in scoured weights. The length of staple was 0.27 inch greater in the C type than in the B type and for each age, except for the 3-year-old ewes, when the length was 0.03 greater in the B-type ewes. The present method of selling wool encourages the B-type ewe with the greater grease weight of fleece and the slightly heavier scoured weight suggests the movement to longer staple by careful selection rather than the abrupt change from B to C in type. Most of the fleeces of both types class as strictly combing on a 2-inch basis as recognized by the Bureau of Agricultural Economics, U. S. Department of Agriculture. (Project 109)

With the publication of Utah Station Bulletin 110 (December, 1930), the project on the feeding value of alfalfa hay treated with calcium arsenate for destroying injurious insects was brought to a close. (Project 110)

The swine-feeding experiment was revised in the spring of 1931 with the following divisions: (1) Summer fattening (alfalfa pasture) and (2) winter fattening (dry-lot). In the 1931 alfalfa-pasture tests the supplemental feeds were skim milk powder and a semi-solid skim milk (cottage cheese). Some digestive troubles resulted in these lots receiving the semi-solid skim milk. Most economical gains were made in the wheat tankage and alfalfa pasture lot, although this was but six cents cheaper per 100 pounds than in the barley-alfalfa lot. In the winter-feeding test, the cheapest gains were made in the lot where ground wheat, tankage, and alfalfa hay were fed, the cost per 100 pounds being \$4.38 as compared to \$5.47 for the ration of ground wheat, semi-solid skim milk, and alfalfa hay. The best gain made was in the lot given ground wheat and alfalfa hay, 50 per cent tankage, and 50 per cent skim milk powder; the daily gain was 1.36 pounds. Utah Station Circular 90 on swine production covers part of the work under this project. (Project 111)

Blood serum agglutination tests on dairy cattle affected with Bang's disease were given every 60 days. Fourteen of the original 22 animals still remain in the herd; 1 cow which reacted negatively in the beginning, still continues to react negatively. The remaining thirteen animals continue to react in approximately the same titre, although there is a tendency for a few of the cows to react only in slightly lower titres; two of the cows which were suspicious reactors at the beginning of the study soon became negative and have continued to remain negative. Five cows, discharging *Brucella abortus* in their milk, showed no organisms in their placental membranes. It would seem that after infection has been established for some time, it probably localizes in the mammary gland and is not found consistently in the other reproductive organs. "Control and Eradication of Bang's Abortion Disease", is the title of a circular (No.94) issued in June, 1931, on this project. (Project 114)

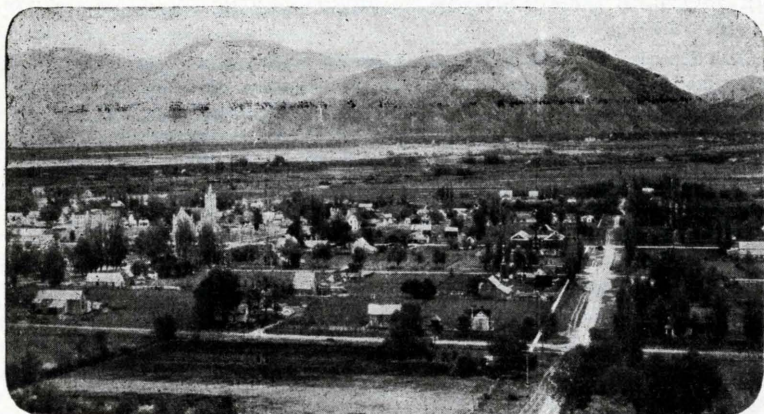


Fig. 10.—A representative Utah farming community where dairying is a major source of income. Because of the plan of land settlement in these communities, the dairy cattle population is concentrated on the town lots where the cows are housed and fed. In summer they are driven to and from pastures surrounding the community.

The study on the transmissibility of Bang's disease among dairy cattle in a Utah dairy village was undertaken to determine the feasibility of handling such cattle when driven together en route to and from pasture during the pasture season. All cattle in the particular community chosen have been tested periodically to determine the presence or absence of Bang's disease. There is a gradual tendency to eliminate the diseased animals, even though most of these animals have shown no evidence of abortion.

The test made in November, 1931, indicated that infection had been introduced during the pasture season into two herds which were previously free from the disease. The third test (April, 1932) showed that infection had been introduced into five herds during the off-pasture season; these five herds were disease-free in November. Available data indicate that the infection may have been introduced into all of these herds by the purchase of untested cattle which later have proved to be infected. The fact that 69 out of the 71 herds tested remained non-infected throughout the pasture season, even though all herds comingled en route to pasture, appears to indicate that the danger of herd-to-herd-disease transfer through this contact is negligible as compared to the danger involved when cows are pastured together and housed together during milking hours. (Project 117)

The follicle method was used in vaccinating 664 pullets for fowlpox, pigeon-produced vaccine being used. Transmissibility studies have also been undertaken in an effort to determine the relationship between mosquitoes and fowlpox. Results at the present time indicate that pox may readily spread among fowls when mosquitoes are entirely excluded. (Project 121)

The susceptibility of cattle to inoculations with acid-fast organisms isolated from so-called tubercular skin lesions is an important phase of animal-disease investigations. Because of the urgent need to determine more definitely the relationship of skin lesions of cattle to tuberculosis, this work has been outlined in cooperation with the State Department

of Bacteriology and with the Bureau of Animal Industry, U. S. Department of Agriculture. Many injections have been made and observations with regard to their tuberculin sensitivity will be continued.

(Project 125)

Dried molasses beet pulp when added to a grain mixture of chopped barley and wheat bran, equal parts by weight, gave no significant difference in production of milk and butterfat with two groups of five cows each during two 60-day feeding trials. The small differences shown were in favor of the barley-wheat bran-grain mixture, both with reference to gain in body weight and milk and butterfat production. During this test approximately 100 pounds of dried molasses beet pulp replaced a mixture of 50 pounds chopped barley and 50 pounds wheat bran.

(Project 131)

Investigations on corn and cottonseed cake as concentrated supplements for wintering sheep on desert ranges in Utah were initiated early in January, 1932, to determine feed nutrients best suited for use with desert forage available for wintering range sheep in Utah. Plants grazed by sheep wintered on the west desert have been collected and will be analyzed during the summer of 1932 for protein, ash, nitrogen-free extract, fiber, ether extract, calcium, phosphorus, and sulphur. Individual weights of sheep in three experimental groups were made at the beginning of the experiment. Weights of wool produced from each flock were also procured, after which the lambs were shipped to summer range and lambled separately, lamb birth weights and breeding being recorded. The sheep and lambs were turned back with the main group on June 15. While data have not yet been completely assembled and analyzed, it is apparent that factors, such as individual herder, condition of range and ranging area as influenced by age and vitality of sheep, had more influence on gains and fleece weights secured than did the supplemental feeds. **(Project 132)**

In a **cattle-feeding experiment**, begun early in January, 1932, in which a study was made of the effect of certain protein concentrates and phosphorus-carrying feeds and minerals fed with a basal beet by-product ration, five lots of eight yearling steers each were fed for a period of 100 days. A basal ration of pressed beet pulp, beet molasses, alfalfa hay, and salt was fed to the five lots. Beet molasses and alfalfa hay were limited to an average daily feed of 3.2 and 9.7 pounds, respectively. The cattle in each lot were allowed all the pressed beet pulp and salt they would consume. Comparable amounts of phosphorus were fed to respective lots in cottonseed cake, steamed bone meal, bran and shorts, and ground barley. Blood samples from the jugular veins of all individuals were gathered at intervals during the experiment and were analyzed for calcium and phosphorus content. This test will be continued; however, younger cattle will be used and ground barley will be fed in all lots; the feeding period will run for 180 days instead of for 100 days. **(Project 133)**

The **Animal Disease Laboratory**, created by the 1929-30 State Legislature, has continued to offer diagnostic service and has reached approximately 1700 farmers. There appears to be a growing interest in the control of Bang's abortion disease of cattle and pullorum disease of chickens. The laboratory is able to assist materially in any control plan developed to reduce the losses from these two diseases, as well as other diseases which often become a real problem for the livestock owner. During the past two years 22,145 poultry specimens have been examined. **(Project 140)**

Botany and Plant Pathology

During the past biennium the following phases of the **virus diseases of the potato** have been especially emphasized: (1) Symptomological studies for the purpose of determining more accurately the expression of the disease in Logan and under greenhouse conditions; (2) testing out early potato-growing areas (Davis and Washington Counties) to determine their value for tuber-index work. The report on symptomological studies has been included in a circular of the U. S. Department of Agriculture, which is being published cooperatively with the Montana and Oregon Stations and with the U. S. Department of Agriculture under the title of "Virus Disease of the Potato in the Pacific Northwest". A publication on virus diseases in relation to seed-potato production will be issued as a Utah Station circular in the near future.

As far as climate and elevation are concerned, Davis and Washington Counties, especially in the areas of Farmington and Washington, can be relied upon to give full expression of the various virus diseases: Rugose, crinkle, mild and leaf-rolling mosaic, as well as leaf roll and spindle tuber. These areas provide for Utah a splendid opportunity for testing annually the seed for these diseases from various seed producers early enough each year for determining the suitability of seed for continued seed production. Tuber-index studies also lend themselves admirably in these two counties. (Project 31)

Effective on July 1, 1931, the study of **tomato diseases in Utah** has been conducted under a cooperative agreement with the Division of Horticultural Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture. This agreement has made possible an expansion of the ~~tomato disease research program~~. A study of the Moapa Valley (Nevada) is being initiated this spring (1932) under a cooperative agreement between the Bureau of Plant Industry and the Nevada Agricultural Experiment Station.

Due to the seriousness of other tomato diseases, investigations on **fusarium wilt** have been temporarily discontinued. For the past two years **bacterial canker** has been particularly serious in the truck garden early tomato crop group in the Bountiful district. Many growers have discontinued tomato production. While generally distributed throughout the canning tomato crop, this infection has not been of a serious nature except in occasional fields. Overwintering studies continue to yield evidence of the ability of the bacterial canker organism to survive the winter and induce the disease the following season under Utah conditions. The percentage of disease which developed following the winter of 1930-31 was less than that which developed following the winter of 1929-30. Inoculation tests indicate that the organism passes the winter with plant debris. Attempts to culture the organism from soil extracts to date have been futile.

Investigations for the past biennium have been confined largely to field studies on control measures. These studies have been segregated into six different phases: (1) Seed selection and extraction studies; (2) rogueing and sanitation studies; (3) crop-rotation studies; (4) seed treatments with hot water, lithium carbonate, and Corona dust No. 201; (5) root treatment; and (6) resistance to bacterial canker.

An investigation of the mode of dissemination of mosaic and streak has been undertaken as a part of the Federal cooperative project on

tomato diseases. The problem of insect transmission has been outlined and work initiated.

During the past two years, curly-top (See Project 141) has become one of Utah's most serious tomato diseases. Survey notes show 56.7 per cent of the tomato plants of the state showing infection during 1930 and the Utah Cannery Association report 42 per cent in 1931.

An investigation of psyllid yellows (See Project 141) on the tomato has been initiated as a problem in differentiation. The symptoms of curly-top and psyllid yellows resemble each other so closely that it becomes necessary to clearly differentiate between the two diseases before selections for curly-top resistance may be judiciously made.

(Project 33)

Funds allowed plant-disease survey work during this period have been devoted exclusively to a study of the distribution of alfalfa wilt and related diseases of the alfalfa and for equipment for prosecution of these studies. In addition to the previously-known distribution of alfalfa wilt in Salt Lake and Davis Counties, the disease was found in a severe form in Utah, Tooele, Millard, Cache, and Weber Counties. In addition to alfalfa wilt, the disease, known locally as witch broom, has been determined to be generally distributed in Salt Lake County. In many fields as high as from 60 to 90 per cent of the plants were found to be affected. Plantings were made in Utah County of 36 varieties of alfalfa to be studied in relation to their susceptibility to bacterial stem blight and bacterial wilt. These studies and plantings were made preliminary to the establishment of Purnell Project 128, on alfalfa wilt and related diseases, which began on July 1, 1931. Reprint 164 reports investigations of the late blight on the sugar-beet.

(Project 34)

The project on nature and cause of chlorosis in Utah and practical methods of control, reorganized in the winter of 1931-32, involves the addition of Division 5, in which are included studies of resistance of small fruits to chlorosis. This phase of the project is conducted in cooperation with the Department of Horticulture, and the report of Division 5 is included under this department. The reports of the first four project divisions, conducted by the Department of Botany and Plant Pathology, follow:

(1) **Treatments of Chlorotic Plants**—Observations of injected trees have been continued to ascertain (1) duration of beneficial effects and (2) effect of wounding incident to the treatment. Great variability has been shown in regard to duration of beneficial effects; in general, however, apple and pear appear to show more lasting effects than peach and cherry trees. Thus far, no indication of infection in the injection holes has been observed. The treatment of cherry trees by the injection method is of questionable value; in all other plants tried, however, beneficial effects have been obtained. The spraying experiments, in which 5 per cent iron sulphate has been used almost exclusively, have demonstrated that chlorotic herbaceous plants, especially raspberries and grapes, can be substantially improved by three applications of the spray. None of the fertilizer trials, involving sulphur, ammonium sulphate, manure, and manganese sulphate, has given any indication that chlorosis can be controlled by such treatment.

(2) **Soil Studies**—Determination of nitrate nitrogen, phosphorus, pH, and water content of soils under chlorotic and normal trees in close proximity to one another has shown no consistent differences between the two conditions.

(3) **Physiological and Biochemical Studies**—Chemical analyses of normal and chlorotic leaves have included the determination of dry matter and ash and the chief ash constituents. The juice has been extracted from frozen leaves and determination made for pH, osmotic concentration, solids, reducing and total sugars. The chlorotic leaves have a lower percentage of dry matter but do not appear to differ much from the normal in total ash content. The only appreciable and more or less consistent difference in ash constituents was found in the case of calcium, which is lower in chlorotic leaves. There is a tendency for the juice of chlorotic plants to have a higher pH value, lower osmotic concentration, lower solid content, and lower concentration of reducing and total sugars.

(4) **Economic Aspects**—Because of limited time and funds available for the chlorosis project no survey work has been undertaken. However, considerable data on the distribution and severity of the disease have been accumulated in connection with the various phases of Division 1.
(Project 89: Divisions 1-4, inclusive)

Results of observation and experimental work from the disease aspect on the **psyllid yellows of the potato**, since its inception in 1928, have been assembled and have been accepted for publication in the JOURNAL OF AGRICULTURAL RESEARCH. Here are reported all the known facts regarding the psyllid yellows in such a form as to permit of the projecting of research on a more detailed but cooperative basis with the U. S. Department of Agriculture. Future work will include: (1) Relation of the nymph to the infective principle involved in the disease, (2) light and other etiological factors influencing symptom expression, and (3) control.

(Project 92-A)

The only work done on the pathological phase on bunt control has had to do with the effect of time of planting on winter wheat infection. Soil, apparently free from smut, was heavily sown with bunt spores on August 28, 1930. Plantings of wheat were then made in this artificially-infested soil at intervals of approximately 10 days from September 1 up to and including November 1. Results obtained on July 1, 1931 indicate: (1) That spores remain viable in the soil over a considerable length of time in the fall, (2) that infection of wheat seedlings may occur throughout the period from September 1 to November 1, and (3) that incident of infection decreases with increased time from period of spore dissemination.

(Project 115-B)

Three phases of the **pathological aspects of the bacterial wilt of alfalfa** have been emphasized: (1) Distributional studies to determine the presence and seriousness of alfalfa wilt in various alfalfa-producing areas in Utah; (2) symptomological studies for the purpose of differentiation of wilt and its effects on the plant from other related diseases of the alfalfa; (3) etiological studies based on isolations and inoculations to ascertain the pathogenicity of Utah strains of *Phytophthora insidiosus* and to aid in a more accurate differentiation of the various diseases complicating the wilt problem.

Wilt has been discovered in a severe form in Cache, Weber, Davis, Salt Lake, Tooele, and Utah Counties. The exact part played in stand reduction and symptom production by diseases other than bacterial wilt (such as bacterial stem blight, crown wart, nematode, witch broom, and possibly dwarf) is difficult to determine. The most difficult problem in this aspect lies in the determination of the possible presence or absence of alfalfa dwarf which affects the alfalfa in a manner similar to that of

the true bacterial wilt. The relatively unknown disease of "ring worm" present in Washington County is also disturbing in the differentiation relations, as this disease also affects the alfalfa plant in a way as to render differentiation difficult. Witch broom, a new disease of alfalfa, presents an additional problem in differentiation. (Project 128-A)

The following phases of the joint aspects of the bacterial wilt of alfalfa have received special consideration: (1) The selection and establishment of farms for long-time experiments on alfalfa wilt; (2) selection of apparently resistant plants from a badly-diseased field; (3) planting of varieties of alfalfa having promise of wilt resistance and of other desirable characteristics; and (4) testing of effect on wilt of different quantities of irrigation water.

After careful survey of fields in Salt Lake County a suitable farm was located at Union, 11 miles south of Salt Lake City. This field consisted of 6.5 acres of land suitable for alfalfa-growing; it also had a water-right for adequately conducting experimental work. Two and one-half acres of this land was planted to 2-year-old alfalfa with 18 per cent wilt infection; 2.5 acres to 4-year-old alfalfa with 90 to 100 per cent infection; and 1.5 acres plowed in 1930 from old alfalfa planted to potatoes in 1931. This field was rented by Salt Lake County from the owner; it was released to the Utah Agricultural Experiment Station for a period of five years, with an option of an additional three years should the work so demand. Forty-seven varieties and selections of alfalfa have been obtained from various sources and planted on the Union Farm.

To study the effects of irrigation on the development of alfalfa wilt, the major portion of the younger (2-year) alfalfa on the Union Farm was divided into six plats receiving different amounts of irrigation water.

Selection of seed was made from 100 plants in a 2-acre field in Hunter and from a field in which the plant population had been reduced during 1929-32 to but a few hundred plants. This selected seed has been planted for testing resistance at the Union Farm on land plowed this year from the old (4-year-old) alfalfa. (Project 128-C)⁵³

Work, in a preliminary way, was begun on the Intermountain Herbarium in September, 1931, since which time 10,432 specimens have been assembled from Utah, Colorado, Wyoming, Georgia, and New York. Of this number 600 sheets have been mounted and placed in herbarium files. (Project 135)

Investigations on curly-top and psyllid yellows of the tomato⁵⁴ began on July 1, 1931, under a cooperative agreement with the Division of Horticultural Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture.

During the past season 40 per cent of the tomato crop of Utah is said to have been infected with curly-top. The constant recurrence of this disease at frequent intervals has resulted in curly-top becoming the most serious tomato disease in the state.

Investigations on this project to date have been concerned with two phases of the problem: (1) Resistance to curly-top and (2) psyllid yellows.

⁵³Project 128-C is conducted cooperatively by the Agronomy and Botany Departments. This report represents the work by both departments.

⁵⁴Separate and distinct from Purnell Project 33 on "Tomato Diseases in Utah" (Fusarium Wilt Bacterial Canker, and Mosaic and Streak). Both are reported jointly by H. L. Blood and F. B. Wann, project leaders.

Resistance studies to curly-top have been conducted at Logan and at Hurricane, the purpose of which is to discover, if possible, any expression of resistance to the disease. Trial grounds which require the proximity of leafhopper breeding grounds have been established at Hurricane. From results obtained, apparently the process of planting spinach in the fall will be highly successful in over-wintering insects on the trial grounds. The large smooth-leaved type (Viroflay) appears to be most admirably adapted. Plantings of 56,700 tomato plants have been made at Hurricane this spring (1932). The year's work at Hurricane indicates that plants which survived the severe infestations of curly-top during 1930 did so either because of chance escape or because of some temporarily acquired resistance. Such survival was certainly not a result of any strongly inheritable characteristic, or it would have doubtless manifested itself in the progeny. It appears evident that when resistance is found it will be expressed in a chance individual that may show up at any time.

Inoculations were made with insects on tomatoes in the greenhouse at Logan in an attempt to determine the efficacy of such a procedure in testing resistance. The inoculations conducted at Logan clearly indicate the necessity of conducting detailed experimental work on the relationship of the number of insects used, the duration of insect feeding, and the age or stage of development of the plant to the expression of symptoms of curly-top. A standard involving these factors must be set in order that any degree of comparative resistance may be measured and selections be made. A study of enzyme activity of curly-top plants may offer some interesting information as to the altered physiological functions which give rise to observed symptoms and contribute towards an explanation of recovery or tolerance.⁵⁵

The characteristic symptoms of curly-top of the tomato include a retarding of terminal growth accompanied by a pinching together of the young leaves at the stem apex, reflexed leaf blades, stunted growth, yellow leaf blades, increased vein coloration, etc. These external morphological changes, together with those produced internally, no doubt arise in response to the altered physiological activity of the diseased plant. This altered physiological activity is also manifested by marked biochemical differences between normal and diseased plants.

The biochemical studies made thus far have centered on the chemical changes. Three series of plants have been analyzed: (1) Plants grown at Logan in the Plant Pathology garden and inoculated at weekly intervals with curly-top; samples were collected at three-day intervals; (2) plants grown at Hurricane and infected naturally; one collection of samples was made; and (3) plants grown in the greenhouse and artificially inoculated. One collection of samples was made. Portions of the samples were used for the determination of dry matter.

The higher values for dry matter, solids, ash, sugars, and osmotic pressure found in curly-top plants reflected on altered physiological activity, resulting in the accumulation of carbohydrates and ash constituents in the leaves. The retarded growth of the diseased plant is also evidence that the carbohydrate reserves are not being utilized in a normal manner. The fact that alkaloids appear to be more abundant in curly-top plants suggests that possibly protein synthesis is interfered with and that nitrogen is being utilized in the formation of the basic material of alkaloids. Evidence for this is being sought in more complete analysis

⁵⁵Reported by H. L. Blood.

of the nitrogen fractions of the plant, as well as in the quantitative determination of alkaloids. These analyses are just being initiated.

In addition to the chemical studies certain determinations of enzyme activity have also been made. These have been confined chiefly to catalase activity, which has been found to be much lower in curly-top plants than in normal ones.⁵⁶

Phyllid yellows is known to be a disease of the tomato and potato in the West. The disease reached epidemic proportions on the potato in Utah and Colorado in 1927, after repeated occurrences for several years previous in certain localities of both states. Due to the severity of the disease on the potato, its cause and nature on that host is being investigated and details of certain phases of the work have been accepted for publication in the JOURNAL OF AGRICULTURAL RESEARCH under the title: "Psyllid Yellows of Potato".

Stocks of psyllid insects (*Paratrioza cockerelli* Sule) from Utah and from California have been bred preparatory to the initiation of intensive work. The insects are carried through the winter with difficulty. Forty tomato plants were inoculated each with 10 nymphs, but cold cloudy weather interfered with the proper expression of the disease and little information of value was obtained.

Future investigational plans call for a detailed study of the distribution, economic importance, host range, symptomatology, nature and cause, insect vectors, physiological and biochemical responses, and control measures.⁵⁷

While the pathological phases of **psyllid yellows of tomato** remain to be worked out, the physiological responses of this host to the disease appear from preliminary observation to be somewhat similar to those of the potato. These include various growth responses of the serial portion of the plant, such as enlarged nodes, cupping and yellowing of the leaves, etc. When infection is severe the plant habit is markedly changed. On the potato, however, if only a few insects are allowed to feed on the plant for a short time symptoms of yellows may be produced only to disappear on the removal of the insects. It has also been shown that light intensity is a factor in the expression of psyllid yellows symptoms. These facts indicate that the nature of the infective material may not be a virus. It is, thus evident that the responses of the hosts to the psyllid infections are largely physiological. It is suggested that the physiological investigations of psyllid yellows be directed toward two objectives: (1) Determination of the morphological and biochemical changes induced in tomato and potato plants by the psyllid contagion; and (2) attempts to reproduce similar responses by artificial means.⁵⁸ (Project 141)

Chemistry and Bacteriology

The study of factors influencing bacterial activities of the soil has been continued. Nitrogen-fixing microorganisms of three alkali soils have received special consideration. Twenty-one organisms have been obtained in pure cultures from native alkali soil and carefully studied morphologically and physiologically. They were found to fix small but appreciable quantities of nitrogen when cultured in soil. Results are included in Reprints Nos. 158 and 163. Nineteen microorganisms obtained from alkali soil have been studied as to their ability to break down

⁵⁶Reported by F. B. Wann.

⁵⁷Reported by H. L. Blood.

⁵⁸Reported by F. B. Wann.

various nitrogenous materials. Their activities were found to vary with the culture medium, soil or liquid medium, specific microorganisms, and the substrate on which they were permitted to act. Results of these studies are given in Reprint No. 174. The quantity of ammonia and nitrates produced and the nitrogen fixed by mixed cultures of soil microorganisms varies with the soil medium and incubation period, as is shown in Reprint No. 195. The growth and metabolism of yeast and certain bacteria were shown to follow the autocatalytic growth formula, the results of which will appear in an early issue of the JOURNAL OF BACTERIOLOGY. (Project 22)

It has been found in permanent fertility studies that both nitrogen and carbon can be materially increased by the application of organic manures to a soil and that appreciable quantities of nitrogen can be obtained from the atmosphere by non-symbiotic nitrogen-fixing microorganisms, provided proper temperature, moisture, and organic content of the soil are maintained. Both manured treatment and irrigation water are found to modify the microflora of the soil. (Project 23)

The past two seasons' work on the composition of the principal irrigation waters of the state shows a wide variation in the calcium, magnesium, phosphorus, potassium, carbonates, sulfates, chloride, and nitrite content of the waters. The quantities vary with the stream and in many cases with the season of the year. Some of the waters carry such small quantities of soluble salts that no damage will result to soils or crops from their use; others are found to carry such quantities that they must be used with care. (Project 24)

In the determination of the nutritive value of high vs. low calcium and phosphorus-carrying wheats, a high calcium-carrying wheat, Kota, and a low calcium-carrying wheat, Turkey, have been fed to rats under carefully controlled conditions. The rate of growth has been found to be about the same on both Kota and Turkey. The irradiation of the wheats or the addition of cod liver oil greatly increased growth in the rats, irradiation being just as effective as the use of cod liver oil, thus demonstrating that both wheats carry considerable provitamin D. The bones of the animals fed on Kota wheat were shown by the "lime test" and by chemical analysis to be superior to the bones of the animals fed on Turkey. The percentage of bone ash, calcium, and phosphorus in the extracted bones and serum calcium and phosphorus were higher in all animals fed Kota (high-calcium) wheat over those fed Turkey (low-calcium) wheat. (Project 105)

In a study on the mineral content of wheat seventy-five wheats grown during two years, representing different varieties and grown under different conditions, have been analyzed for ash, calcium, magnesium, potassium, phosphorus, sulphur, and iron content. The composition was found to vary with variety, season, water, and soil. Probably soil is the most important factor; however, considerably more work must be done before final conclusions can be drawn. (Project 107)

Entomology

A study of wheat samples collected in 1930 from various parts of Utah showed that on the average, one-third of the culms of irrigated and dry-farm wheat were infested with the wheat strawworm, *Harmolita grandis* (Riley). The infestation of irrigated wheat by this insect was 29.31 per cent in 1931, while the infestation in dry-farm wheat was only 19.64 per cent. The wheat jointworm, *H. tritici* Fitch, occurs in a few

areas, principally in dry-farm wheat in the Tooele-Erda area and the Starr (Juab County) area. One sample of irrigated wheat taken at Garland was slightly infested by the jointworm.

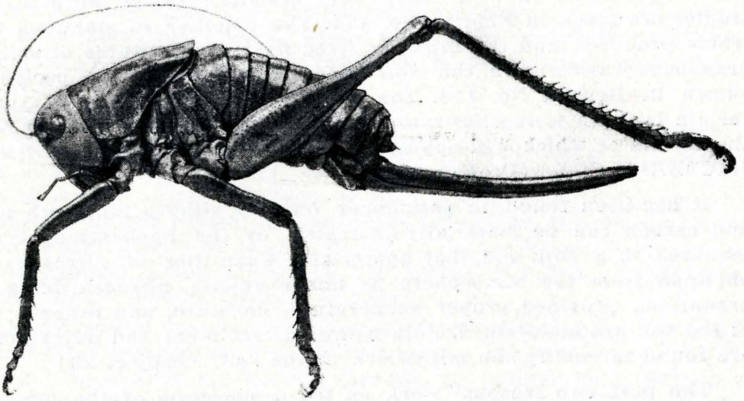


Fig. 11.—Western or Mormon cricket, *Anabrus simplex* Haldeman—female.

Grasshoppers were extremely abundant and damaging in many parts of Utah during 1931. Practically all agricultural crops in areas of high infestation suffered from attack. **Dipterous parasites**, principally *Sarcophaga kellyi* Ald., destroyed large numbers of adults during the fall of 1931, and **blister beetle** larvae destroyed many egg masses during the same fall and the following spring. However, large numbers of eggs were deposited in some areas, and by May, 1932 serious outbreaks had occurred in parts of Sanpete, Sevier, and Millard Counties. A large series of baits was used in tests and good kills were obtained by the use of most of the baits commonly in use, provided they were properly mixed and applied during the early morning of clear days when the temperature was between 70 and 80 degrees F.

The **boxelder bug**, *Leptocoris trivittatus* (Say), is often extremely annoying as a household pest. A thorough spraying with pyrethrum and oil or with strong kerosene emulsion, if done when the bugs congregate on walls of buildings in spring and fall, will greatly reduce the numbers and incidentally reduce to a great extent household annoyance from this pest. Many of the commercial household sprays are effective in killing this bug when it enters houses.

The following publications on this phase of the miscellaneous insect project have appeared: Utah Station Bulletin No. 221 and Reprints Nos. 152, 154, 157, 159, 162, 166, 181, 182, 183, 185, 186 and 196. (Project 51-A)

During the alfalfa growing seasons of 1926 to 1929, while the investigations of the chalcis-fly project were being carried on, it was observed that the **tarnished plant bug** (*Lygus pratensis* Linn.) occurred in great numbers in the alfalfa-seed fields of the Uintah Basin and in Western Millard County. The **superb plant bug** (*Adelphocoris superbus* Uhl.) was observed to occur in rather considerable numbers, and myriads of **thrips** were present in the alfalfa-seed fields after the blossom period had begun. An effort to determine the relationship of these insects to the production of alfalfa-seed was, therefore, undertaken. Special study has been made of the relation of these insects to flower-

drop in alfalfa which has been a conspicuous phenomenon in the alfalfa-seed fields of the state during the past five or six years.

Life-history studies of the tarnished and superb plant bugs, begun in June 1931, still continue. Excellent progress has been made with studies pertaining to the tarnished plant bug, but considerable difficulty has been experienced with those of the superb plant bug. During May, June, July, and August, 1931, surveys were made at 10-day intervals in Western Millard County and semi-monthly in the Uintah Basin for the purpose of ascertaining the population and seasonal distribution of the various insects which are known to cause or were suspected of causing damage to alfalfa-seed. Thrips may cause some injury in connection with the setting of alfalfa-seed. Further study is necessary and is in progress at the present time.



Fig. 12.—Tarnished plant bug, *Lygus pratensis* (Linn.).

For the first time in recent years the alfalfa weevil made its appearance in the alfalfa-seed districts of Western Millard County and in the Uintah Basin in such numbers as to injuriously affect the production of alfalfa-seed from first-growth alfalfa. Excellent control of the weevil was had at the Uintah Basin Alfalfa-seed Experimental Farm by the application of a 50-50 per cent calcium arsenate-sulphur dust applied at the rate of 5 pounds per acre with a traction duster. Detailed results of this treatment are contained in Utah Station Circular 98 (April, 1932).

During the summer of 1931 experiments were performed to test the efficiency of nicotine, sulphur, and cyanide dusts for the control of tarnished and superb plant bugs, thrips, and chalcis-flies. However, none of the dusts tested proved effective in destroying these insects under field conditions. (Project 51-B)

Investigational work on the chalcis-fly in alfalfa-seed has been a continuation of studies previously reported and has consisted of: (1) The seasonal distribution of the alfalfa-seed chalcid, *Bruchophagus funebris* How., and of its parasites; (2) life history of *B. funebris*; (3) methods for its control; and (4) the extent of chalcis-fly infestation in the 1930 and 1931 alfalfa-seed crops of Utah.

Sweepings were made at 10-day intervals in Millard County; similar fields in the Uintah Basin were swept at intervals of two weeks during May, June, July, and August of 1930 and 1931. The same fields have been swept each year with but few exceptions, when the latter were rotated to other crops.

From alfalfa-seed samples collected in representative seed fields of the state, the overwintering chalcids contained in them were emerged

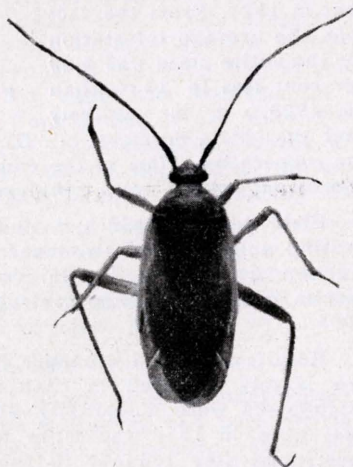


Fig. 13.—Superb plant bug, *Adelphocoris superbus* (Uhler).

in the laboratory during February, March, and April. Segregation counts were made of *Bruchophagus funebris* How. and its parasites, *Eutelus bruchophagi* Gahan and *Liondontomerus perplexus* Gahan.

Results of cultivation tests with various tillage implements for the control of chalcis-flies indicate a possibility of some degree of control. Results of community cooperative effort, in the small isolated Mills Valley (where approximately 100 per cent of the growers cultivated their fields in early spring and cleaned up all chaff stacks and prevented the seeding of volunteer alfalfa), showed a decrease in the "fly" infestation for the district from an average of 35.9 per cent in 1929 to 5.53 per cent in 1930. From the fact that the average infestation for the entire state was 6.29 per cent less in 1930 than in 1929, it is unlikely that the entire decrease in "fly" infestation in Mills Valley was due to the cooperative effort of the community; however, it appears that rather significant results were obtained.

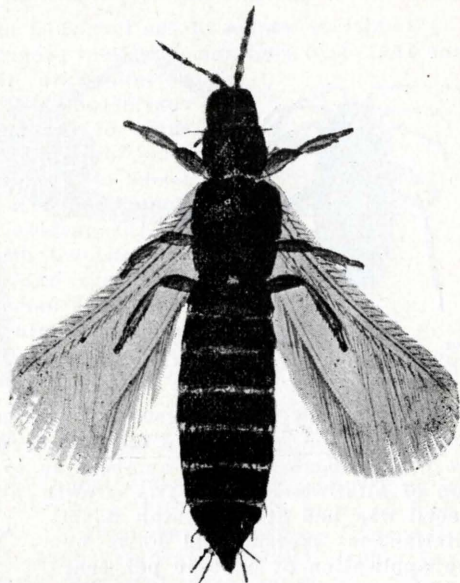


Fig. 14.—Thrips, *Frankliniella occidentalis* (Pergande).

Field tests in which 4 and 6 per cent homemade nicotine dusts, dusting sulphur, and Cyanogas were applied with a traction dusting machine at rates of 15, 25, and 50 pounds per acre gave no positive results in an attempt to control chalcids in the open field during July, 1931. (Project 80)

Results of beet leafhopper investigations up to the winter of 1931 are largely reported in Utah Station Bulletin 234 (May, 1932). Beet leafhoppers were moderately abundant over the northern Utah sugar-beet area in 1930 and more abundant in 1931, with the yield being most noticeably reduced in the areas near Garland, Lehi and Payson. The severe drought was an important factor in reducing yields in the beet districts and in reducing beet leafhopper populations in the desert breeding grounds. This project is conducted in cooperation with the Bureau of Entomology, U. S. Department of Agriculture. (Project 82)

Potato psyllid investigations from the insect aspect have been reported in Reprint 173. Three to four generations of *Paratrioza cockerelli* (Sulc) developed in the field at Logan during 1931. Apparently, matrimony vine, *Lycium halimifolium*, is one of the principal plants upon which the potato psyllid breeds in early spring; many plants are used as a source of food early in the season, but eggs are not laid on most of these. Potato psyllids were rather scarce in northern Utah during the season of 1931 and were observed in only a few fields in this area. On May 6, 1932, 228 adult *P. cockerelli* (139 males) were collected in 100

sweeps of the net from matrimony vine at Plain City. The mortality in hibernation cages was much higher where the adult psyllids were allowed to become wet than in cages where they remained rather dry. No parasitism of *P. cockerelli* has been observed, but adults and larvae of ladybird beetles, chrysopid larvae, and one adult anthocorid bug have been observed to be predaceous upon this psyllid. Extreme hot weather in summer appears to be an important factor in retarding the development of large numbers of psyllids during July and August. It is planned to determine, if possible, the more important fall and spring host plants of the potato psyllid. (Project 92-B)

Geology

An attempt has been made to determine the source and amount of water-supply in all of the areas of Utah which promise **underground water** in sufficient quantities for irrigation. As the summer of 1931 was exceptionally dry an opportunity was afforded to gather valuable data regarding the measurements of the annual recharge from the underground water reservoirs during a dry season as well as to determine the amount of recharge following a period of drought. Detailed checks have been made and measurements taken on all of the principal flow and pump wells of the state, and a detailed log of most of the characteristic wells of the underground water sections has been recorded.

A complete check was made in the spring of 1931 of the wells in Cache, Boxelder, Weber, Davis, Salt Lake, Utah, Juab, Sanpete, Washington, Sevier, Iron, Beaver, Millard, and Uintah Counties to determine whether or not the increased precipitation of the water had affected the amount of recharge. A slight rise of water was indicated in Cache County, in the Beryl district of Iron County, and in the Milford Flat of Beaver County. A further study is now being made with check wells to determine the amount of recharge in these districts during the summer. All indications point to a general rise of ground water during 1932.

Present information indicates that the limit of the underground water-supply has been reached in such areas as Flowell, while in Iron County additional limited developments may be made without injuring any of the wells now in operation. Accurate and detailed data concerning this project will soon be available. (Project 25)

Home Economics and Human Nutrition

Prior to 1930 the study of food habits of elementary rural school children in relation to their physical well-being had been carried into two rural schools in Cache County (total enrollment, 326 children.) Dietary information was secured by various means. In the fall of 1930 the investigation was carried into two rural schools in Utah County and into two rural schools in Boxelder County. Included in the investigation, also, were 25 children from the 97 whose families had supplied the dietary information for Utah Station Bulletin 213 (July, 1929).

The following data were obtained in two years' study from children in six rural schools:

- Food-habit records from 939 children
- Food preferences from 633 children
- 924 children were examined by a physician
- 909 children had dental examination
- Health-habit records were secured from 985 children
- Histories of communicable diseases from 993 children
- Height-weight-age records of 828 children

Numerous tabulations have been made of this material; analyses of diet and of physical status have also been made. The work of tracing possible relationships between diet and physical status is in progress. A manuscript covering results of this study is in course of preparation as a Station publication. (Project 102)

In a feeding experiment on the physical curd character of milk and its relationship to the digestibility and food value of milk for infants, a large number of samples of human milk was obtained from two large hospitals in an effort to determine the curd character of human milk. Unfortunately all of these samples were in the early colostrum stage and would not coagulate with pepsin or rennin. An effort is being made to devise an instrument for testing a small amount of human milk. This will make it possible to determine the curd character of this milk with only 10 cc., whereas at the present time 100 cc. samples are required.

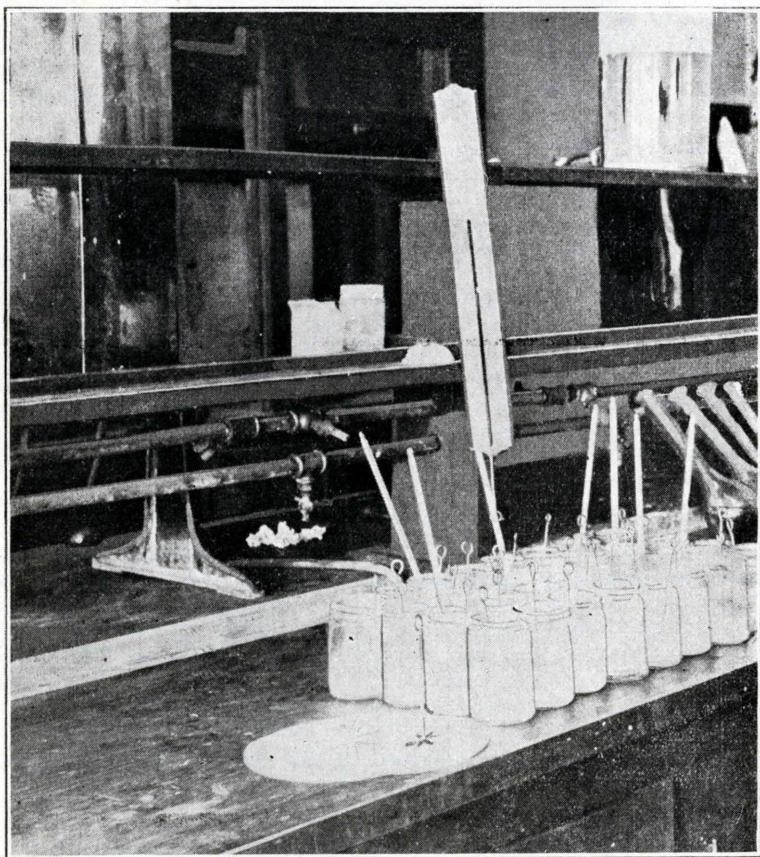


Fig. 15.—Equipment used in Hill Test for determining the soft-curd character of milk. The pull required is read directly on the spring balance. About a third of the way down on the spring balance is located the pointer. The hook of the spring balance is looped through the ring of the curd knife, preparatory to drawing the knife through the curd, as is done in actual test. The pointer indicates a pull of approximately 65 grams.

A large number of cows have been tested, the results of which have been tabulated and published as Bulletin 227 of the Utah Station (June, 1931). Reprints 172, 184, and 191 also report results of this phase of the project.

The milk from several hundred goats has been tested for hard-curd and soft-curd. These results have now been summarized and will be ready for publication in the near future. (Project 103)

Tests on the **physical curd character of evaporated milk** have been made on more than 2000 samples of milk from the three condenseries in Cache Valley. These samples were taken on the raw milk, in the hot vats after heating the milk, and on the milk after the final evaporation but before sterilization; samples were also taken after the sterilization process. These results are summarized in Utah Station Bulletin 227 (June, 1931). A confirmatory check is being run on each of these three condenseries at the present time. At the conclusion of this test, this project will be closed. (Project 103-A)

High-altitude metabolism studies were observed on seven college men and eleven college women during the months of April and May, 1932, in an effort to determine whether men at this altitude (4776 feet) had the same consistently low rate as women in the two previous studies had shown. Athletes were also chosen for subjects, since it is a well-known fact that activity has a carry-over effect which would raise the basal rate an appreciable amount. Every precaution was taken to insure accurate results, and only those subjects who were willing to cooperate in the matter of early dinner and early-retiring hour were accepted.

The results of this study showed that the basal rate in every case is below the average accepted normal line, ranging from a minus 10 per cent to a minus 28.7 per cent (in the case of men) and a minus 2.7 per cent to a minus 20 per cent (for women). These results are in agreement with the results of the first two studies made in this series. From a total of 72 readings on these 18 subjects, the results show that 72 per cent of the men had a minus deviation exceeding the normal of minus 10 per cent and that 46 per cent of the women had a similar deviation. The comparison of athletic with non-athletic subjects does not show consistent differences. One athletic man had the least deviation, while another had the greatest. One athletic woman had the least deviation and another had about the average for the group. In the main, the athletes followed the same general tendency as the entire group as well as the groups of preceding studies. A total of 536 readings has now been taken on acceptable subjects, and it is perhaps significant that no plus values have been secured on either sex or on athletic or non-athletic groups. (Project 104)

An investigation on the effect of **physical curd character of milk on the quality, yield, and physical texture of cheese** has been conducted. These studies have demonstrated the marked superiority of hard-curd milk over soft-curd milk for the manufacture of cheese. Reprint 151 briefly reports the findings of this project. Further results of this research are being compiled and will be published as a Station bulletin, after which the project will be closed. (Project 106)

In the spring of 1930, questionnaires were sent to 530 women in rural Utah to ascertain the types of **greens (both cultivated and wild) or pot plants used in Utah homes**. Studies of farm-family diet, completed or in progress, indicate little use of greens, with a corresponding lack of iron in the diet of rural families. It was believed that greater knowledge of

available greens would tend to increase their consumption, thereby increasing the iron content of the diet at little expense, or at no expense at all. Thirty-three per cent of these questionnaires were returned with the desired information. A manuscript, based on this study, is in process of preparation. This will contain general information on greens, which might be a part of the family vegetable garden, as well as information that will enable Utah housewives to take advantage of wild greens growing in their immediate neighborhood. The cooperation of the Botany Department has been secured in photographing and in describing desirable wild greens. (Project 113)

As an outgrowth of Project 102 (Food Habits of Rural School Children in Relation to their Physical Well-being), the study of factors promoting positive health in rural school children was begun in the fall of 1931. Preliminary work included: (1) Selection of children for the study, (2) perfecting equipment, and (3) training field assistants.

A dietary history of each child selected has been worked out as well as the quantitative character of each child's present diet. A record of the health history of the children under observation, as well as of their parents and grandparents, is being carefully kept. Home environment as well as community aids to health are considered in determining those factors which aid in promoting positive health of rural school children. (Project 118)

Horticulture

During the first year of this biennium the work of the Davis County Farm was carried on under the direction of a farm foreman, during the absence on leave of the superintendent. No new work was initiated during this period and some of the more technical phases of previous studies were omitted. Since the fiscal year begins in the middle of the crop year, the work of the second year of the biennium was also affected by plans made during the first year. Consequently, the work of the entire biennium has been largely crop improvement by selection and series of variety tests.

In addition to the experimental work with vegetables and small fruits, this project includes the administrative work connected with the Davis County Farm, which condition has existed from the establishment of the farm. However, in August, 1931, the project was completely reorganized. All major studies were segregated and set up as independent projects. In some cases budgets were combined for administrative reasons under the general head of Project 59, while in other cases projects carried their specific budgets. Several miscellaneous studies were still retained as units of the general project. Most of these were of minor nature which at present do not merit the status of separate projects. Other studies are preliminary to anticipated future projects.

In June, 1931, a tract of land consisting of 2.35 acres was purchased and added to the Davis County Farm. This purchase removed an objectionable corner which was bounded by the original farm tract on two sides and has now squared out the farm. It also provided land for some badly needed fertilizer studies. Part of this tract, together with adjacent land on the previously-owned tract, was too wet at certain seasons for crop production. Its purchase justified a drainage project on the part of the Experiment Station. Such a system was installed in the fall of 1931.

Four concrete hotbeds, each 60 feet long, were constructed during the second year of the biennium. This permitted the abandonment of the worn-out lumber hotbeds and made it possible to enlarge the ser-

vice yard. A hotbed hot-water heating system was installed, as well as switch boxes, outlets, and conduits for an electrical hotbed heating system. A small shed was built to house this equipment.

The summers of 1930 and 1931 were both unusually dry ones. As a result, crops did not make normal growth. The tomato work of 1930 was a failure due to an epidemic of curly-top; it was injured in 1931 by dry weather. The heavy windstorm of April 22, 1931, blew out nearly all of the small seeds, seriously interfering with the onion work in progress. Studies with paper caps for forcing tomatoes, eggplants, and peppers, were entirely ruined. Although it was necessary to use extreme care, irrigation water was adequate both in 1930 and in 1931.

Grasshoppers stripped the leaves from plants on the north side of the farm in 1931. Apparently they hatched on the adjacent hillside and roadway and migrated to the cropped area. Blackberry and raspberry experiments were destroyed. Complete recovery cannot be expected until 1933.

Part or all of the work of the following projects is being carried on at the Davis County Farm:

- 122—Factors Affecting the Keeping Qualities of Onions
- 123—Improvement of Sweet Spanish Onions
- 124—The Use of Plant Protectors and Paper Mulch in Vegetable Production
- 126—Factors Affecting the Formation of Doubles and Scallions in Onions
- 127—Miscellaneous Onion Studies
- 129—Variety Tests of Small Fruits
- 130—Methods of Plant Growing and Plant-growing Structures

In addition, the following departments have carried on work during this biennium:

- Horticulture: Tree-fruit variety tests
- Botany and Pathology (in cooperation with Bureau of Plant Industry): Tomato diseases
- Botany and Pathology (in cooperation with State Department of Agriculture): Checking certified seed potatoes for certain diseases
- Agronomy (in cooperation with Bureau of Plant Industry): Cereal variety tests

In 1932, 70 selections of canning tomatoes were grown; of these, fifteen were chosen for further study. Some of them appear to have superior merits from the standpoint of color, size, or texture. Nearly two hundred selections from wilt-free vines were made from 1924 to 1923. Many of these have not been adequately tested. Nearly 100 of the most promising selections were planted in 1932 to determine their value for canning purposes.

Some minor crop-studies have been carried on with celery, cucumbers, sweet corn, sweet potatoes, and snap beans. Most of these have been variety testing. Some preliminary experiments to determine the value of removing the sucker growth from sweet corn indicate that this is not only unnecessary but that it also reduces yields. (Project 59)

The study of peach harvesting indexes has been closed and the data are being prepared for publication as a Station bulletin. (Project 86)

This phase of the chlorosis work—the development of chlorosis-resistant varieties of small fruits—assumes that some varieties of raspberries, strawberries, grapes, and other small fruits are more or less resistant to chlorosis when grown under conditions conducive to the

disease. Moreover, it assumes that some individuals in otherwise susceptible varieties show various degrees of resistance. Observations made previous to the formulation of the project support these assumptions. During the late summer and fall of 1931, observations were made on 21 varieties of raspberries, 30 varieties of grapes, and several varieties of blackberries. Several selections were made of apparently resistant individuals of several varieties of raspberries. Those were planted in a new plat of ground together with plants of 20 varieties obtained from the Davis County Farm, where chlorosis is not a problem. These plants were set 5 x 3 feet apart in order to more easily identify the canes from each plant. Several hundred plants of Marshall, Sionilli, and Bouquet strawberries have been planted on the chlorosis plats to obtain, if possible, resistant individuals. Other varieties will be added from time to time. (Project 89—Division 5)⁵⁹

In order to facilitate rooting of the **orchard layered rootstocks** in the experimental nursery, which did not take place freely with the mazzard and mahaleb cherry layers and the various pear stocks when mounded with soil, in early October, the shoots were slit diagonally at the base and covered with German peat moss, which was then covered over with soil. When examined in April, 1932, to determine if they were sufficiently rooted for removing, practically all the shoots so cut and treated had produced callus, and most of them were developing roots; however, they were not rooted well enough to cut off and line out. Paradise apple layers from the East Malling Station (England) were fairly well-rooted and were removed and lined out in the lath house where they are starting well. The mazzard, mahaleb, and myrobolan seedlings planted last year have grown well and will be layered this fall. After sufficient numbers of each are propagated, selections will be made of the more promising rootstock clones for field trials.

In spite of an unusually hot July in 1931 which killed many newly set trees in commercial orchards, the trees in the cherry rootstocks test orchard came through with only a moderate loss. It is noticeable that the loss was much heavier on the trees on Stockton morello roots. Whether this indicated lack of "transplantability" on the part of this stock or was due to drying out in handling is not known. None of the cherry stocks used at present are as easy to transplant as is desirable, as heavy losses of newly set cherry tree are reported every year, even with careful handling and planting. Fall planting is not practical here because of winter injury.

Death of many bearing trees in certain sections of Utah appears to be due to the larvae of the California prionid beetle which partly girdles the trees at the base. In the small number of trees where this damage occurred which has been investigated so far, all of them are on mazzard rootstocks which raises the problem as to the relation of the rootstock used to damage by this borer, which apparently is killing out profitable bearing orchards of sweet cherries in some sections.

Because of the difficulty encountered in the after-ripening and germination of sweet cherry seed to be used in the seedling rootstocks parentage trials, an experiment in storage and after-ripening of sweet cherry seed has been conducted during the past season. Of nine varieties used in the experiment, the mazzard seedlings and Napoleon had the highest percentage of sound seed, 98 and 92 per cent, respectively;

⁵⁹Divisions 1-4, inclusive, of Project 89 are reported by Botany and Plant Pathology Department.

Windsor, Schmidt, and Lambert were between 85 and 90 per cent sound: May Duke, Black Tartarian, and Centennial were lowest, with only 75 to 80 per cent normal or non-abortive seeds. The mazzard seedlings gave a higher percentage of germination than any of the cultivated varieties. Over 500 seedlings from various varieties resulting from this work will be used for further rootstock tests. (Project 93)

Although 231 crosses were made involving 97,000 blossoms, bad weather interfered with **cherry pollination**, causing a light set of fruit on most of the test lots. Normal sets were likewise low, averaging 19.8 per cent. Pollination by brushing Lambert branches with Schmidt (Black Orb) and Black Tartarian blossoms increased the set over the naturally pollinated checks 120 and 83 per cent, respectively, while May Duke gave only 38 per cent increase. The tree used was located 17 rows from a known pollinizer, the results indicating insufficient pollination. Trees in the same block which had bouquets of Tartarian and Schmidt (Black Orb) blooms hung in buckets during the blossoming season set 33.8 per cent as compared to 12.6 per cent on the check tree, an increase of 168.3 per cent. Interesting new strains and varieties tested this year include the Black Oxheart, a Bing sport, and two new types of Black Tartarian. (Project 94)

All of the land allotted to the **tree fruit variety-testing work** on the Davis County Farm has now been planted to promising new fruit varieties. The test orchard at the present time includes 227 named varieties, distributed among the following fruits: Cherries, 37; apricots, 22; peaches, 89; plums, 51; nectarines, 14; pears, 5; nuts, 3; jujubes, 6. In addition, 450 seedlings of Chinese apricot and a number of cherry seedlings are being tested. The 1928 plantings of peaches and apricots bore last season. In a test planned to compare Early Elberta, Elberta, and J. H. Hale varieties of peaches, which are the only varieties grown for distant shipment in Utah to date, Early Elberta is proving to be the most vigorous and productive of the three varieties. The largest tree attained a spread of 16 feet at the end of the fourth growing season. Of the varieties of peaches which ripened fruits this past season, the Golden Jubilee, South Haven, Rochester, Ideal, and June Elberta (Arp Beauty) appear to be the most promising. All of these are yellow freestone peaches which ripen from two to four weeks earlier than Elberta. June Elberta proved to be quite soft and variable in color, limiting its possible value to local market purposes. The others named are rather firm-fleshed and are promising for shipping purposes as well as for local market. All but a few of the varieties from the Foreign Plant Introduction gardens matured late and are not winter-hardy; of these, the Ideal and Up-to-Date appear to be the most promising.

Of the apricots, none appeared equal to nor superior to the Chinese in fruit characters in its season, with the exception of Montgamet, which appears identical with it. From its history, it is probable that the Chinese is the Montgamet apricot renamed. Moorpark has borne earlier and heavier than Chinese in the test.

The test orchard at Logan now includes 140 varieties of fruits, of which 53 are apples, 40 plums, 17 pears, 11 cherries, 11 peaches, and 8 apricots, with a few filberts, walnuts, and sand cherries included.

(Project 95)

Investigations on the **Boxelder County Farm** were initiated following an appropriation made by the 1930 Utah State Legislature for **investigation on stone-fruits** in Boxelder County. Preliminary work was started on July 1, 1931. Yield records on individual trees were secured

as a basis for comparing later experimental treatments. In spite of the appearance of uniformity, a wide variability in yield was shown, averages for the rows to be used for plats varying 40 per cent from the mean. Because of soil variations and lack of suitable land for new plantings, it was decided to continue work on this tract on a temporary basis and to select a permanent site with more typical and uniform soil conditions upon which to build up experimental fruit plantings.

Cooperative irrigation work with the Division of Irrigation Bureau of Agricultural Engineering, U. S. Department of Agriculture was begun in November, 1931. In addition, different pruning treatments are being tried. A striking vegetative response to a heavy application of manure is evident. While the unpruned and thinned-out trees have the heaviest set of fruit before the 'June drop', the headed-back trees are making the most vigorous new shoot growth. (Project 119)

As a result of an appropriation for experimental work in Washington County made by the Utah State Legislature of 1930 because of the peculiar conditions and problems faced by the agriculture of that county, a ten-acre tract of land was selected in August, 1931. This tract, known as the **Washington County Farm**, is leased by Washington County. Field work was started in December of the same year. The farm is located immediately west of Hurricane and is typical of much of the fruit and vegetable district of the county. The farm is devoted to fruit, vegetable, and plant disease work. The experimental work is divided into the following divisions: (1) Orchard heating; (2) Tree-fruit variety testing; and (3) vegetable and small fruit tests. Tomato-disease studies, under Projects 33 and 141, are also conducted for the most part on this area.

On account of the prevalence of killing frosts as the principal limiting factor in orcharding in Washington County, **orchard heating** was initiated to study its relation to local conditions and to determine its practicability as well as to secure data as a guide to successful practice. Four different types and makes of heaters (350 in all) were secured for experimental heating tests under actual orchard conditions. Suitable thermometer equipment was set up. Although frost has destroyed the crop in this orchard four years out of the past six, no frost occurred this spring; hence, no major heating tests were possible. Considerable data of value were secured, however, on rate of burning and length of burning period of different types of heaters recommended for deciduous fruit heating, as well as residue and combustion tests on oils from several local wells. (Project 120-A)

Variety testing of tree fruits, initiated by the planting of a 4-acre variety test orchard this spring, has for its purpose the testing of promising new varieties of fruits for the early districts of Washington County. Principal emphasis has been placed on early varieties for shipment to northern markets, although many varieties are being tested for local and nearby markets which absorb a considerable share of the fruit produced in this section. A total of 181 varieties was planted: Apples, 53, peaches, 37; nectarines, 3; cherries, 21; apricots, 11; plums, 32; pears, 21; and quinces, 3. A test of peaches, plums, and dwarf pears as fillers is being made. A pruning experiment comparing modified leader training, open-center training, and no pruning of young peach trees is being made with the fillers. It is planned to make experimental plantings of walnuts, almonds, pecans, pistachio nuts, pomegranates, figs, jujubes.

Japanese persimmons, and other new fruits next season. However, one or two acres of additional land will be needed for these plantings.

(Project 120-B)

The vegetable and small fruit test on the Washington County Farm was not started until February, 1932; consequently data are not yet available from the first year's study. The following work, however, is in progress at the present time:

1. Date-of-planting studies with several vegetables
2. The possibility of starting plants in cold frames and beneath plant protectors to increase earliness
3. Variety tests to determine suitable varieties of vegetables for Washington County. **(Project 120-C)**

The project on factors influencing the keeping qualities of onions was not approved until September 1931; therefore, materials were not available for the prosecution of this project during the past winter. However, some preliminary observations were made. In one instance several crates of onions were harvested before the tops had fallen. Half of them were topped immediately and placed in a ventilated room to cure. The other half was windrowed in the field and topped about a week after harvest. Both lots became rather wilted within a few days after pulling because of their immature condition; however, these later hardened. Onions from this same field were pulled when the tops had fallen, windrowed in the field, and topped about a week after pulling. Part of them were bagged and moved to storage without being wet. The other portion was topped but lying on the ground during a rainy period of nearly one week. After they became dry they were also placed in storage. In February both lots which were harvested when slightly immature showed no decay; those harvested mature and stored before the storm showed considerably more decay; those which had been rained on were badly decayed. A rather interesting observation was made relative to the color of the different lots. The bulb scales of the onions harvested when immature had not yet developed the color characteristic of the variety, whereas the color of those harvested when mature was fully developed. The outer bulb scales of the immature group did not color normally, but the third and fourth scales developed a more lustrous and uniformly distributed color than did those harvested in a mature stage.

Onions were planted at the Davis County Farm this spring to amply meet the needs of this experiment. They have made splendid growth. Irrigation treatments were initiated on June 15. Arrangements have already been made for storage space in which to conduct the storage tests. **(Project 122)**

Studies on the improvement of Sweet Spanish onions have been underway for about eight years as a unit of Project 59, the general project covering the Davis County Farm. During the general revision of the vegetable and small fruits program in 1931, this was set up as a separate project. Previous to this time a strain of Sweet Spanish onions of unusual merit has been developed by mass selection and a number of pureline selections made. The mass selection has been in demand by commercial growers and now forms the foundation for the strain grown by several onion seed-growers. Most of the purelines were lost through grasshopper injury in 1929; those remaining were planted at the Davis County Farm in 1931. The wind of April 22, 1931, completely destroyed this work. Small amounts of seed of twelve selections, remaining from previous years' plantings, were planted in spring of 1932 as a basis for

a new beginning. Additional selections will be made from time as promising specimens are found.

Work has progressed satisfactorily on the isolation of a white Sweet Spanish onion. While most of the seed planted in 1931 was blown out in the windstorm of April 22, several ounces of seed were secured from bulbs selected in 1930. The few bulbs secured from the 1931 planting showed less of the yellow color than any preceding selection. About 40 pure white bulbs were saved from this lot for the 1932 seed crop. A comparison of six local strains of Sweet Spanish and one commercial strain was made. While this planting was also damaged by wind, some data on color and shape were obtained. In these respects all of the local strains were superior to the commercial strain.

An attempt has been made to produce seed in the greenhouse during the winter months in order to save one year in the selection program. Bulbs were subjected to different storage temperatures for different lengths of time before planting. From the studies made thus far, apparently onions do not require a rest period. The largest number of seed stems was secured from bulbs planted in the greenhouse immediately after harvest. One-half of the bulbs in each treatment were grown under normal length of day, while the remainder were given additional light until 12 o'clock midnight. The plants under the latter treatment went to seed about a month earlier than those under normal day. Apparently, a crop of seed may be grown in the greenhouse during fall and winter by planting the bulbs as soon as harvested and providing supplementary light until midnight. (Project 123)

The use of plant protectors and paper mulch in vegetable production has been conducted only in a preliminary way. However, peppers, eggplants, and cabbage were grown on paper mulch in 1931. There was little difference either in earliness or total yield in the case of peppers. In the case of eggplants, however, 317 pounds of fruit were harvested from paper mulch as compared to 68 from a comparable number of plants in the check rows. Whether this is sufficient to pay for the extra cost is questionable. Cabbage was earlier on paper mulch, although the total yields were about the same.

A preliminary study of soil nitrates under paper caps as compared to the open field was started in 1932. An attempt is being made to correlate this with differences in growth and composition of plants grown under the two conditions. These data are incomplete at present. (Project 124)

The study of factors underlying the formation of double onions and scallions was approved in September 1931. Since it was too late at that time to provide the field conditions specified in the project outline, only preliminary work could be done. Previous observations indicated that doubles and scallions were more numerous in fields where the stand was thin than where it was thick. In order to determine if soil nitrates might be a factor in the formation of doubles, soil samples were taken early in the summer of 1931 from portions of a field where the stand was poor as well as from a portion in which the stand was good. Samples of onions were also preserved from these same areas for chemical analysis and for histological study. Complete tabulation of data from chemical analyses is not yet finished. It appears from the nitrogen studies that the nitrate content of the soil where the stands were thin is considerably higher than where the stands are thick. This is reflected in a higher soluble nitrogen content in the plant, particularly in the early

stages of growth. There is a higher insoluble nitrogen content in the plants where the stand is thin. The difference seems to be greater during the green-onion stage and tends to become less as the plants approach maturity. Scallions also have a higher soluble nitrogen content in the stem, neck, and tops than do normal bulbs, just preceding the neck collapse of the latter. The insoluble nitrogen content does not differ between the two types. While these differences in chemical composition are distinct and consistent, it must be remembered that they are the result of only one year's work. Subsequent studies may not substantiate these differences. Onions have been planted at the Davis County Farm to study the effect of thickness of stand and frequency of irrigation on the formation of doubles and scallions. It is also planned to determine whether or not heredity is a factor. Material for histological studies has been fixed and imbedded, but the slides have not yet been made.

(Project 126)

Under miscellaneous onion studies, seed-production studies were conducted in 1931 according to the plan followed for the past six years. The results are not entirely in agreement with those of past years, in that the uncut bulbs equalled the topped and cut-once bulbs in yield of seed.

The plants from the cut-twice and topped bulbs came up earlier than from the other treatments and were damaged most by the windstorm. In 1927 a severe late frost produced the same result, except in that year the uncut bulbs outyielded all others in seed production. During the present year (1932) with its unusually favorable growing conditions, the topped bulbs were in the best condition on June 1. Whether they can maintain this position is questionable. At any rate, the uncut bulbs have consistently produced a poorer stand and less seed per plant under normal conditions. When abnormal conditions occur between the time when the wounded bulbs come up and the later time when the uncut bulbs come up, however, the latter make a better showing.

The comparison between seeds and seedlings for the production of Spanish onions was started in the spring of 1932. Data are not yet available. A comparison is being made between Utah Valencia plants grown in Texas and seed of the same stock sown at about the same time as the plants were set out. Crystal White wax onions are being grown from Texas-grown seedlings during 1932. Data, however, will not be available until late summer.

During 1931 Mountain Globe Danvers onions were grown to determine whether or not Utah could supply onions for the August market and thus extend the period of onion marketing. Thrips damaged these plants so badly that the onions did not reach marketable stage. However, they did ripen a month earlier than did Sweet Spanish planted on the same day. With adequate thrip control it appears possible for Utah to market onions a month earlier than at present by growing an earlier variety.

A brief paper was prepared on onion-seed studies and published in the Proceedings of the American Society for Horticultural Science (1931: 336-341). (Project 127)

This project on variety tests of small fruits in the past has been carried as a unit under Project 59, the general project for the Davis County Farm. It was set up as a separate project late in the summer in 1931. As a unit of Project 59, it has been more or less inactive since 1928. Previous to 1928, a large number of varieties of raspberries and blackberries and several varieties of currants and gooseberries had been

accumulated. During the leader's absence from September 1928 until April 1931 these varieties were merely maintained. In 1931 grasshoppers injured the blackberries and raspberries so severely as to make records of no value, and wind destroyed the currant and gooseberry blossoms. Consequently, the first reliable records for gooseberries and currants will be taken this year (1932); blackberry and raspberry data will be recorded in 1933. The damage to the latter crops was so severe that most of the canes were winter-killed; it will require another year to recover from this injury.

Strawberry variety tests have been conducted during the past four years. Previous to 1928 about 70 varieties had been included in the project. From 1928 to 1930 the varieties under observation had been reduced to Marshall, Bouquet, Sionilli, McAlpin, Bliss, Early Bird, and Aroma. In 1932 the following varieties were added: Fruitland, Washington, Big Late, Jupiter, Red Heart, Bellmar Corvallis, Chesepeak, May Queen, Mastodon, Premier, Harvest King, Red Gold, Blakemore, and Rockhill. Some of these are new varieties, while others are standard sorts, most of which have not been included in previous tests. As soon as funds and space are available, it is planned to expand this phase of the work to include several other varieties not yet tested.

Some selection studies with Marshall and everbearing superb varieties were started in 1932. Plants have been set 3 feet apart in the hope that superior individuals might be isolated upon which improved strains of these varieties may be founded. This same type of work could be done to advantage with other small fruits. (Project 129)

The study on methods of plant-growing and plant-growing structures includes (1) types of hotbeds; (2) value of transplanting; and (3) value of pots in plant growing. To date, types of hotbeds is the only phase having received attention. Comparison was made between manure-heated, electric-heated, and hotwater-heated hotbeds for growing tomatoes, peppers, and eggplants. A lead-covered heating cable was used for heating the electric beds. A No. 2 Wasco hotwater hotbed heater was used to furnish heat for the hotwater-heated hotbed: A mixture of coke and bituminous coal was used in the stove. A layer of cinders was placed beneath the soil in the electric and hot-water beds. While the plants emerged two days earlier (and the rate of early growth was greater), in the electric and hot-water-heated beds, the final results all favored the manure-heated hotbeds. Plants in the hot water and electric beds grow to be about 2 to 3.5 inches in height, stopped growing, and turned yellow. It appeared to be a typical case of nitrogen starvation. A sodium-nitrate solution was applied to the hotbeds of this experiment and to two other beds. Within a week the plants turned green and resumed growth. It appears that the presence of the cinder layer is responsible for the difficulty. The injury may be due either to an inadequate soil supply, in which the nitrates become quickly exhausted by the large number of plants, or it may be due to leaching of nitrates into the porous cinder layer. There is probably no necessity to supply the cinder layer in well-drained soils. In case this porous layer is used, it will be necessary to fertilize with some nitrogen carrier. Because of their larger size the plants from the manure-heated beds were of much better quality, although the smaller plants from the other beds were hardier. All three lots withstood transplanting equally well. Flea beetles injured the smaller plants more than the larger ones. (Project 130)

Irrigation, Physics, and Soils

Under technical studies of the physical and physico-chemical processes in soils work has been continued on the effect of replaceable sodium, potassium and calcium on the physical character of soils. A preliminary paper was presented at the spring meeting of the Utah Academy of Sciences(1932) covering a portion of this work. Laboratory work has been carried on in the development of equipment for studying the colloidal properties of soils by means of the photo-electric cell. A preliminary report has been made in a paper presented to the Utah Academy of Sciences; this work, however, is not completed. Some additional work of a technical nature has been undertaken in connection with the dispersion of soil mineral aggregates, which is still in process. Reprint 193 is a report of part of the work under this project. (Project 12)

To further study some factors which influence the reclamation of water-logged and alkali land a large well was constructed within the Cache Valley water-logged area on the State Highway north of Logan. Electrical energy was made available by extension of a power line, and a 12-inch deep-well impeller pump was installed and operated by means of a 50-HP vertical shaft motor. The influence of artesian wells and of pumping water from an artesian basin on the static water-levels and on the depth of water-table has been given further consideration. Results of six years' field work have been assembled for publication as a non-technical Station bulletin. These results show substantial lowering of the static water-levels(or of the piezometric surface) in the basin within a distance of 2500 feet or more from a large deep-well pump that draws a stream of nearly 4.5 cubic feet per second from the water-bearing gravels. The water-table during 1931 was appreciably lower than it was in 1930. The lowering of the water-table was due in part to the lowering of the static water-levels by artesian wells and pumping and in part to the unusual dryness of the season of 1931.

New applications of Darcy's law to certain problems in drainage design have been made and two theoretical papers have been prepared and published. Attention has been given to the theoretical aspect of the movement of water through the soil and an effort is being made to summarize important fundamental principles underlying this and related subjects. Twenty acres of the 30-acre Bell experimental plat were leveled; eight acres of the area are being used for alkali studies in connection with the drainage experiment. The 8-acre tract has been divided into twentieth-acre plats and the work of sampling the plats has been completed. Alkali determinations on these samples by the electric-bridge method is well underway. Preliminary trials of cropping of parts of the Bell farm indicate that the higher and less saline areas will produce fair yields of barley, clover, and alfalfa. Reprints 193 and 194 cover part of the work under this project. (Project 17)

This project on the relationship of stream discharge to precipitation with special reference to forecasting the supply of water for irrigation from seasonal surveys of snow cover on mountain watersheds now involves the measurement of winter precipitation on high watersheds, the determination of watershed characteristics, the amount and distribution of the early spring and late fall rains, temperature, evaporation from snow and ground surfaces, ground storage, vegetal cover, and runoff. The measurement of the precipitation and the determination and evaluation of the factors causing the water loss constitute a problem which

must be solved before water-supplies can be forecast with any degree of accuracy. During the past biennium the collection of data on snow cover, summer precipitation, and stream flow has been continued. A 9-year record on the Logan River Drainage area is now available. The runoff during the entire nine years of record has been below normal. The runoff during 1930-31 was only 50 per cent of the average of the record. In spite of the fact that the record is short, it covers a dry cycle. It indicates some of the basic principles underlying the stream-flow-precipitation relationships. Studies to date indicate that the snow cover on April 1, temperature during melting season, early spring precipitation, and the watershed characteristics are the major factors to be considered.

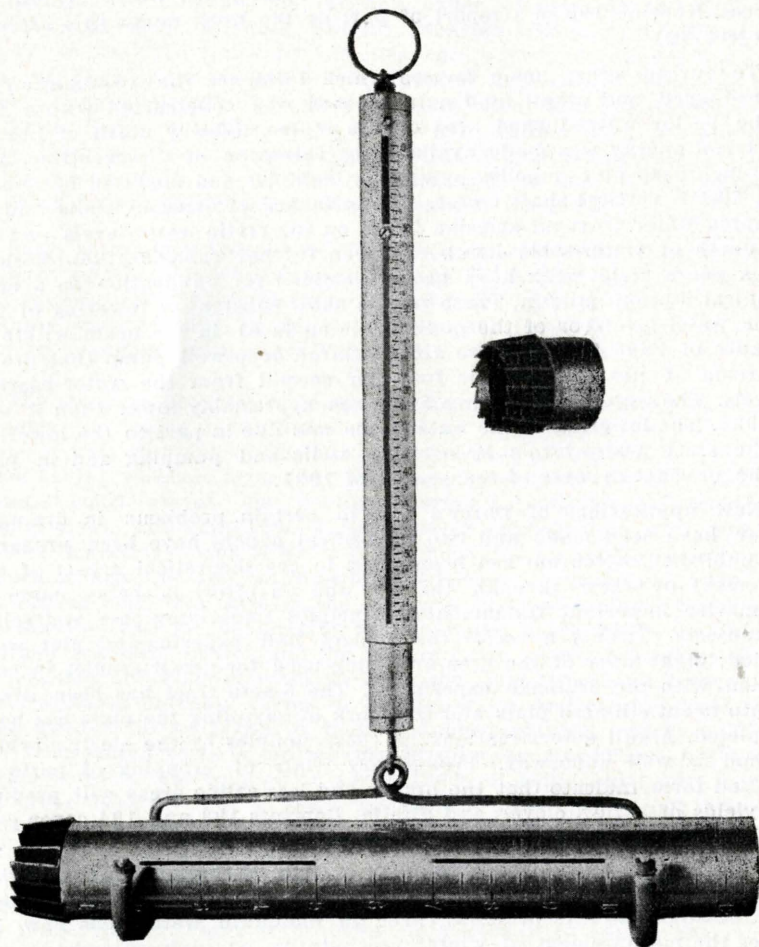


Fig. 16.—Utah snow sampler and scales in position for weighing.

A net-work of the state-wide snow-surveys continued under the co-operation of the Utah Agricultural Experiment Station, the United States Forest Service, and the United States Weather Bureau has been established and snow surveys made for two years. These snow surveys

cover the principal watersheds of the state and furnish the basis of water-supply forecasts for all streams in Utah. State-wide snow-survey data have been published in various Utah climatological reports.

Results of several years' measurement of precipitation in the valley and on the mountains in Northern Utah have been brought together and published. These data show that there is little or no collaboration of the runoff from the mountain areas and the runoff from the valley areas, which means that records of valley precipitation are poor indicators of mountain runoff. Results of the study of snow-melting characteristics have been completed during the past biennium and have been published as Utah Station Bulletin 231 (August, 1931).

A manuscript is now in preparation covering the progress and results of a 10-year study on the precipitation-runoff relationship on high watersheds. Annual forecasts of water-supply in the principal streams in Utah are now being made, based on the state-wide snow-surveys. The short records available on most of the courses furnish to date an indication of what the water-supply might be. On the Logan Watershed, with a 9-year record, it is possible to predict the April-September runoff within 15 per cent and the July-September runoff within 10 per cent. As more records become available it is believed that these forecasts may be made with a considerably higher degree of accuracy.

Equipment for making observations of the water content of snow-cover has been improved during the past biennium. This is described in Utah Station Circular 99 (June, 1932). Other publications on this project during the biennium are Circular 91 and Reprints Nos. 161, 171 and 198. (Project 72)

A study of the factors influencing the financial condition of certain Utah irrigation and drainage projects, during the past biennium, includes the assembling of detailed information concerning water deliveries to individual farmers. Records for the years 1926 to 1931, inclusive, are complete insofar as the records are available. Field investigations have been made in all the drainage districts as well as on some lands not in any drainage district. Investigations have also included the study of water-application efficiencies on various soils, the results of which have shown that there is great opportunity for improvement in the methods of irrigation. Maps of some of the drainage districts, showing cultivated and uncultivated areas, have been obtained, together with pertinent information from the representatives of the bondholders' committee regarding the delinquencies in bond payment and policies of the committee concerning settlement or liquidation. (Project 90-A)

In a study of factors influencing the financial condition of certain Utah irrigation and drainage projects, complete chemical analyses have been made on a number of the soil samples collected from the soil types in Millard County under the canals of the Delta and Melville Irrigation Companies. The data on friability index, shrinkage coefficient, and moisture have been tabulated; satisfactory progress has been made in an attempt to correlate these measurements with the physical properties of the soils. The crop yield data collected in 1929 and 1930 under 90-D have been carefully analyzed in relation to soil types.

Cooperating with 90-C, additional farms have been located on single soil types; crop yield data have been collected from these farms, cooperatively with 90-D. (Project 90-B)

Complete chemical analyses are being made from samples collected from the plats on the 6-acre fertilizer tract near the Campus, under the

project entitled "The Effect of Fertilizers on Various Properties of a Highly Calcareous Soil and on the Yield and Quality of the Crops Produced." However, none of the samples is completely analyzed as yet, but a large number is nearing completion. (Project 91)⁶⁰

After considerable study and observation a suitable tract has been selected for stone-fruit irrigation studies, so far as soils and location are concerned. The problem to be solved is that of securing adequate funds for operation and water in sufficient quantity for irrigation. Irrigation studies are being carried on in Boxelder County to determine the ease and completeness of penetration and the response to cultivation and to irrigation. (Project 119-B)

Range Management

Study on range reseeding with native forage plants has been continued on the effect of depth of planting on germination and growth of mountain brome grass (*Bromus polyanthus*). Greenhouse tests were conducted in sand, sandy loam, and clay soils at depths ranging from the surface to 4 inches. Germination and growth were relatively poor in sand; clay soil produced slightly higher germination from deeper plantings than did sandy loam. In all soils the germination percentages secured from 3- and 4-inch depths were too low to be profitable. Results of field plantings indicate the best depth to be 1 to 2 inches, since the shallower plantings were adversely affected by dry soil and produced germination only following heavy rains. With *Bromus polyanthus*, the depth at which crowns develop bears a close relationship to depth of planting, whereas field brome *Bromus inermis* and slender wheat grass (*Agropyron tenerum*) show variation.

Mountain brome grass was used in a spacing test with intervals of 6, 12, 18 and 24 inches. The 6-inch spacing gave the highest yield both in the fall and in early May and the 12-inch spacing was highest on May 24, the acre-yield being 1.75 tons dry weight. (Project 61)

In range-management studies for the project on corn and cottonseed cake as concentrated supplements for wintering sheep on desert ranges of Utah, 42 plant samples of important forage species were collected for chemical analysis. Identification, however, is still only tentative, although definite identification has been made for curly sage (*Artemisia nova*), Brigham tea (*Ephedra nevadensis*), curly grass (*Hilaria jamesii*), white sage (*Eurotia lanata*), blue sage (*Artemisia tridentata*), rice or sand grass (*Oryzopsis hymenoides*), and yellow or horsebrush (*Chrysothamnus*). Most of the 42 plants collected contributed in some degree to the winter forage of sheep. Acreage estimates were obtained as well as descriptions of types, estimates of species, composition, palatability, and general notes on range conditions and sheep movements. (Project 132-B)

During the summer of 1930 some time was spent in studying miscellaneous flood control problems, in cooperation with the Geology Department of the Utah State Agricultural College, the U. S. Forest Service, and the State Land Board. Results of this study were made available in a printed report (Utah Station Circular 92) by a commission appointed by Governor George H. Dern to ascertain causes of floods and possible prevention measures. This study disclosed a startling need for knowledge of methods and plant species suitable to revegetating range lands toward the end of preventing possible future flood disasters. No number assigned)

⁶⁰For further report of Project 91, see Agronomy Department.

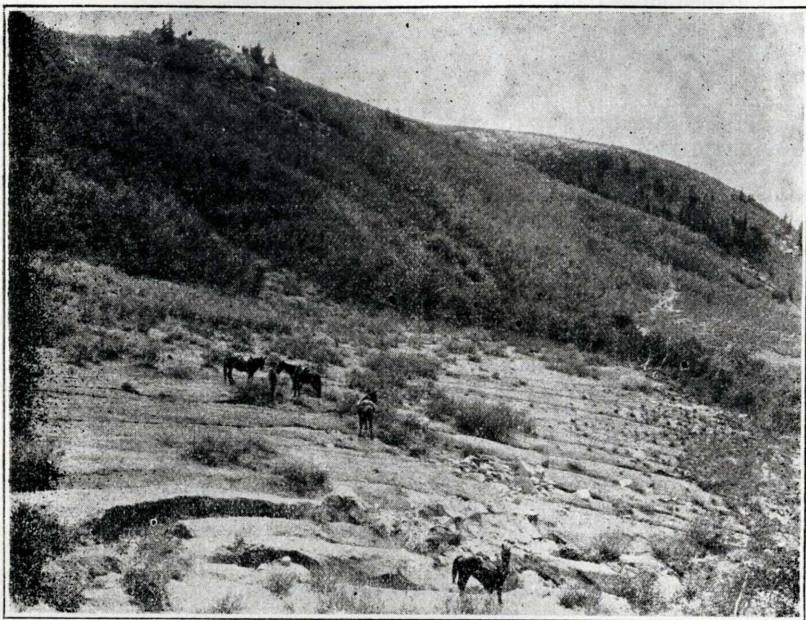


Fig. 17.—View near the head of Ford Canyon, after the flood of 1930. The bare slopes of low gradient shown in the foreground contributed far more to the runoff than did the steeper aspen-covered slopes in the background.

Rural Sociology

Studies of Utah towns and villages, No. 1 has included: (1) Rating of reading material read by 68 families during four months; (2) study of several community attitudes at Plain City; (3) home-building and home-ownership development; (4) clarification of group-participation material, and (5) tabulation and interpretation of data.

A rating sheet was devised which was used in rating done by the cooperating record-keeping farm families. An effort has been made to determine how certain channels of thinking have come to be so firmly established in certain groups.

A cooperative arrangement was entered into with the Extension Service during the summer of 1931, in gathering certain data for President Hoover's Conference on Home-Building and Home-ownership. This information was closely related to objectives already achieved in Project 88. It was considered desirable to enlarge the scope of the study sufficiently to include the data in question. Since the new data came well within the scope of the original plan it was not necessary to reorganize but to expand somewhat along lines already begun. With some financial support from the Extension Service and also with some field assistance, the desired information has been obtained and is in process of tabulation.

The record of participation at Plain City by the four groups under observation in Project 88 is now practically complete. All agencies providing services of a voluntary type were included. (Project 88)

The sociological aspects of main Project 90, **A Study of Factors Influencing the Financial Conditions of Certain Utah Irrigation and Drainage Projects**, has consisted principally of:

A tabulation of the status of each farm in the four drainage districts with respect to drainage taxes (delinquencies and penalties) and state and county taxes (delinquencies and penalties) for each year from 1918-1929, inclusive. This material has been obtained through the County Treasurer and has been certified by him.

The data for 84 farm families studied under Project 90-D have been checked with respect to types of soils involved.

Late in the summer of 1931 the leaders of Subprojects A and B cooperated in locating straight type soil families in sufficient number to represent fairly adequately each soil type for the area. Later in the year field work was done in securing data from these farm families as well as from families living on straight and mixed type soils, which had been used earlier under 90-D.

The schedules which were prepared for the Delta study were sufficiently detailed to make it possible to compare it with other areas outside of Utah where standard-of-living studies have been made and also to provide a basis for comparison with other Utah studies which have been completed as well as those which may be undertaken in the future. (Project 90-C)

GENERAL FINANCIAL STATUS

In common with every other unit of the State Government, the Utah Agricultural Experiment Station, during the biennium just closed, has been obliged to operate on a budget seriously curtailed by the general economic conditions limiting income. Retrenchment was of special urgency during the last six months of the biennium when, in order to conform to the Governor's request for reductions in all departments and institutions, budget allowances on State funds were reduced 20 per cent. Provisions were made also for continuing on this retrenchment basis during the fiscal year 1932-33; all Station salaries will be reduced as of July 1, 1932, to conform to institutional policy in this respect.

The problem of retrenchment was rendered the more difficult because of the falling off of sales revenue which resulted from low prices for farm products. In this respect, the Station was placed in exactly the same position as the farmers of the state. There was practically no market for some produce and no satisfactory price for any of it. Fortunately, the Station carried over into the second year of the biennium a small balance from the first year; this, together with the federal funds regularly available under the Hatch, Adams, and Purnell Acts, enabled the Station to meet its retrenchment requirements without loss in personnel or disaster to its research program.

Details of the financial status of the Station are published in the annual report of the Financial Secretary of the Utah State Agricultural College for the fiscal year ending June 30, 1932, to which readers are respectfully referred. In general, however, it may be said that, despite the seriousness of the problems curtailed in the general retrenchment policy mentioned as well as those incident to the general falling off in sales revenue, the Station has managed to avoid incurring any deficit and faces the next fiscal year in a condition which at least permits of maintaining its form and its major functions.

RECOMMENDATIONS

One of the peculiar effects of the depression, insofar as the Station is concerned, is that the volume of work has been increased while operating funds have been decreased. This is different from what is reported by industrial circles at large, where reduced volume of business is cited as the chief justification for reducing expenditures. It is when agriculture is in most distress, however, that calls for help are most numerous; and the present is no exception to that rule if the number of requests filed with the Station constitute a dependable criterion.

To meet these requests, the Station is doing its utmost, even though it means sacrifice of certain plans and excessive labor on the part of personnel. There is no disposition on the part of any staff member to do less than that, and everyone is willing to do as much more as possible.

In times like these it is extremely distasteful to make recommendations involving greater expenditure of State funds. There are, however, some things that must be urged as matters of public welfare. Not to advance these recommendations would be to shun an administrative duty.

The Agricultural Experiment Station should be provided with a state-owned farm of adequate size, located near the College, to permit of efficient operation. At present the Station is obliged to lease nearly all of the farm land it uses in the vicinity of the College. This is an arrangement which, for obvious reasons, makes for less efficiency and effectiveness than would be realized upon owned property. There probably will be no time in the future when suitable land can be purchased at a more reasonable price than now. The State, in other words, would gain much by securing land at this time, even though the initial cost, in a depression, might seem large. A good Station farm could be secured now at a very nominal rate.

The Experiment Station does not recommend the establishment of any additional outlying experimental farms. There is the obvious danger of having too many of these, that is, so many that their cost in the aggregate would become greater than the benefits likely to be derived from their continued operation. Instead of having more farms, it would be advisable, in the interest of efficiency, to make certain of the effective operation of existing farms which satisfy present needs for field laboratories of this type. To operate these farms properly, however, the budget for the next biennium should be increased. This is an urgent need if the Boxelder and Washington Farms are to be placed on a plane comparable to that contemplated by the last Legislature.

The poultry plant should be further enlarged to provide for studies with turkeys and other types of poultry. At present, Station poultry work is confined largely to the egg-laying breeds of chickens.

Provision should be made for suitable receiving and isolation quarters for experimental animals, as hogs, lambs, and beef steers, brought to the campus for feeding tests. Such facilities would help to keep death losses at a minimum and would avoid unnecessary exposure of animals in the College herds.

It is recommended that provision be made for expanding the Station's research program as related to (1) weed control, (2) forage production and (3) pasture management. Some work in each of these

fields has been done for years past, but on such a limited scale as to be only partly effective. The weed problem in Utah continues to menace the State's agriculture, and every reason exists for attacking it by more comprehensive research than has been possible heretofore. Forage production is threatened by the presence in Utah of the bacterial wilt of alfalfa, already destructive in some counties. Since alfalfa is the basis of the state's forage supply, other than range feed, it is imperative that nothing be left undone that would help to provide control, if not extermination, measures needed in the fight against this disease. The importance of devising better pasture management methods in Utah becomes more apparent as the dairy industry expands and the value of good pastures is more widely appreciated.

There are a number of range problems to which the Station should devote more attention, if resources permitted. A meager beginning was made last year on the great and pressing problem of supplemental feed for sheep on the winter range. It is hoped more of this kind of work may be done. Continued effort would be more than justified also with respect to such problems as flood control, revegetation studies, and watershed problems more particularly related to snow cover, stream flow, and runoff. Then there is the all-important problem of underground water development and utilization, which is demanding more attention annually. Most of these problems are so broad in scope as to be almost beyond the present limitations of the Station's facilities, but through cooperation with various federal and state agencies, the Station is doing at least something toward their solution. It could do much more if resources permitted.

The last Legislature provided the Station with one additional research greenhouse. At the same time the heating plant was renovated. It was recommended at that time that two houses be granted, but the appropriation was sufficient only for one house and the new boiler. There is urgent need for another house, and it is hoped that this may soon be provided.

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